MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 36 FEBRUARY, 1930 Number 6

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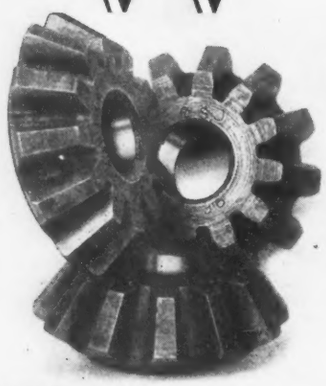
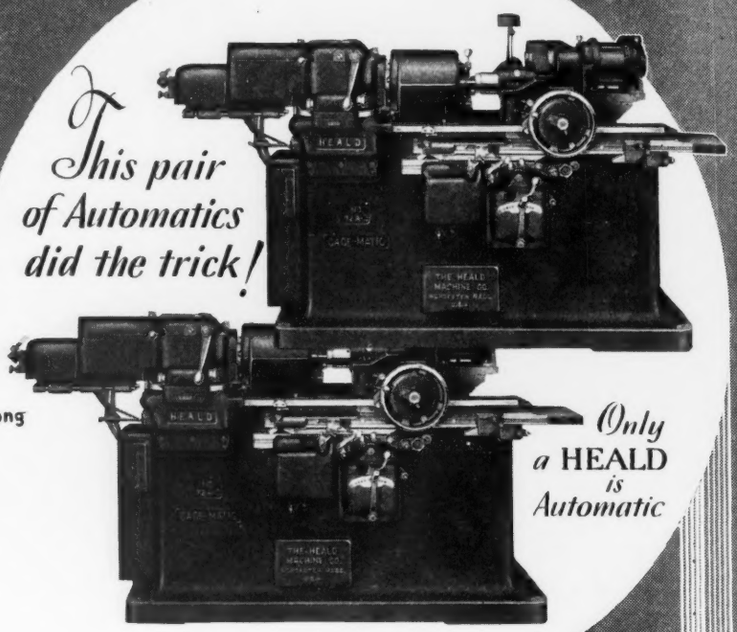
Would 254 Per Hour Interest You?



This pair of Automatics did the trick!



Name	Bevel Pinion Gear
Material	Hardened Nickel Steel
Size of Hole	3/4" dia. by 13/16" long
Tolerance	.001
Stock Removed	.012 - .015
Machine	Gage-Matic Internal

PRODUCTION PER HOUR

254 per one operator per two machines

Only a HEALD *is Automatic*

HANDLING two Gage-Matics set to a cycle of 127 per hour, one operator turns off 254 pieces every sixty minutes day in and day out. This is over double what had previously been obtained by one operator on each machine.

This tandem operation is only possible by the use of automatic equipment that allows the second machine to be unloaded and loaded while the first automatically performs the entire grinding cycle without any attention from operator.

Furthermore, there is no question about the size being maintained, as a solid positive plug automatically gages each and every hole. Operated singly or in batteries, the Heald Gage-Matic AUTOMATIC is paramount for mass production work.

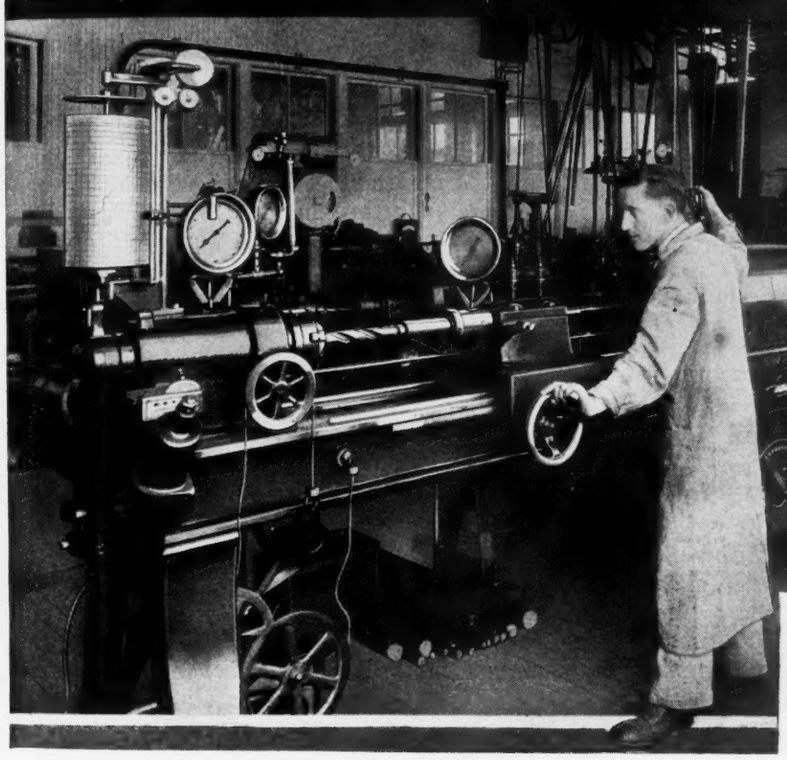
The Heald Machine Company, Worcester, Mass., U. S. A.

HEALD

MACHINERY

Volume 36 NEW YORK, FEBRUARY, 1930 Number 6

Laboratory Tests Aid Tool Development



Proposed Designs of Tools are Carefully Investigated in the Testing Laboratory of the Morse Twist Drill & Machine Co.

By CHARLES O. HERB

THE potential performance of metal-cutting tools depends upon the soundness of their design, the materials from which they are made, and the quality of workmanship put into them. All three of these important factors should be carefully investigated in bringing out a new product. They should also be checked from time to time, in order to make sure that the products continue to measure up to the standard of quality originally specified.

Physical testing and chemical laboratories are maintained in the shop of the Morse Twist Drill & Machine Co., New Bedford, Mass., for the purpose mentioned. These laboratories, especially the physical testing laboratory, have been of great value in placing new tools on the market. For instance, before the concern brought out a spiral taper-pin reamer some months ago, exhaustive tests were conducted to determine whether the flutes should be right- or left-hand, what number of flutes would give the greatest efficiency, the most desirable helical angle, etc. The object was to obtain a tool having the greatest cutting capacity with the least amount of torque.

Complete records are kept in the physical laboratory of every test made, for future reference. One test of a tool is never considered sufficient, two, three, and four tests always being performed before a definite conclusion is reached. Some of the investigations made and the equipment used will be described in this article. In addition to the activities referred to, this laboratory is also responsible for the quality of all work produced by the shop.

Determining the Properties of Raw Materials

Out of every shipment of bar stock received at the plant, one sample of each size is sent to the physical testing laboratory for a Brinell hardness test. Fine chips are obtained by milling the sample, and the chips are sent to the chemical laboratory for a complete analysis of the various constituents. The hardness tests are conducted after a small area of the specimen has been ground on a floor-stand machine and smoothed with a file, so that the impression produced in the test can be clearly seen when inspected under a Brinell microscope.

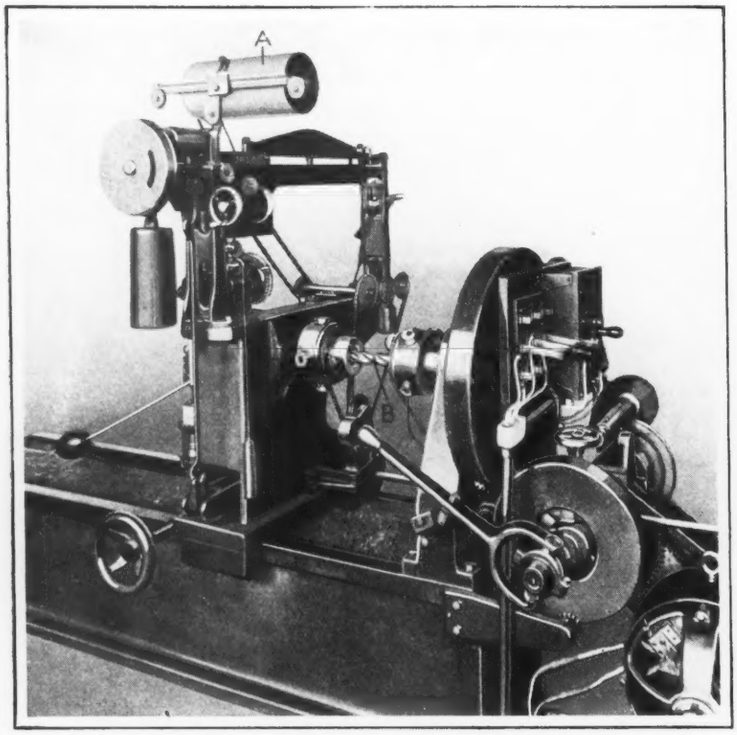


Fig. 1. Machine Employed for Twisting Specimens in Two in Order to Determine Various Properties

The impression is produced in the Olsen compression testing machine illustrated in Fig. 2 by placing the standard load of approximately 6614 pounds (3000 kilograms) on the specimen for one-half minute. This is accomplished by merely moving the weight along the scale beam to the correct position. The beam is graduated to 100 pounds, and a dial vernier permits adjustment to 1 pound.

Before the weight is applied, the specimen *A* is brought into contact with a 10-millimeter ball in holder *B* by operating the ratchet mechanism on the base. When the weight is applied, the ball is pulled or squeezed downward into the specimen. The hardness of the specimen is, of course, determined by measuring the width of the impression through the Brinell microscope and comparing it with a standard table of hardness numbers.

Raw Materials and Tools Checked for Various Properties in Torsion-testing Machines

Raw stock, drills, reamers, and other tools are checked in the Olsen automatic and autographic torsion-testing machine shown in Fig. 1, for the elastic limit of the material, in pounds per square inch; the maximum torsional moment, in inch-pounds; the shearing stress, in pounds per square inch; the angle of torsional elastic limit; the maximum angle of torsion; and the modulus of rigidity. All these properties are given on graphic chart *A* by a pen which moves across the chart as the weight feeds outward along the scale beam.

The specimen is gripped in a chuck at both ends, as indicated at *B*, the left-hand chuck being held practically stationary by a mechanism that connects it to the indicating apparatus of the graphic chart. The right-hand chuck is driven by a 1 1/8-horsepower variable-speed motor which may be run at speeds of from 400 to 1200 revolutions per minute. Large worm and spur gear reductions reduce the speed to such an extent that the slowest motor speed gives a chuck speed of 1 revolution in 6 3/4 minutes.

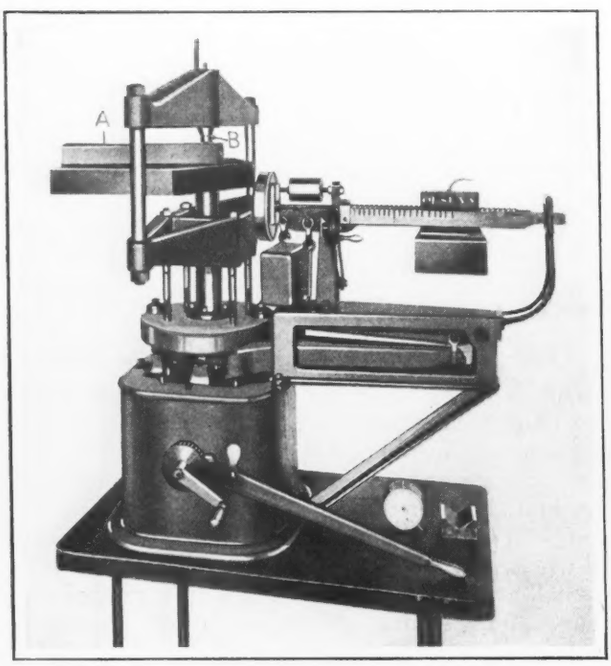


Fig. 2. Machine in which Impressions are Made on Specimens for Brinell Hardness Readings

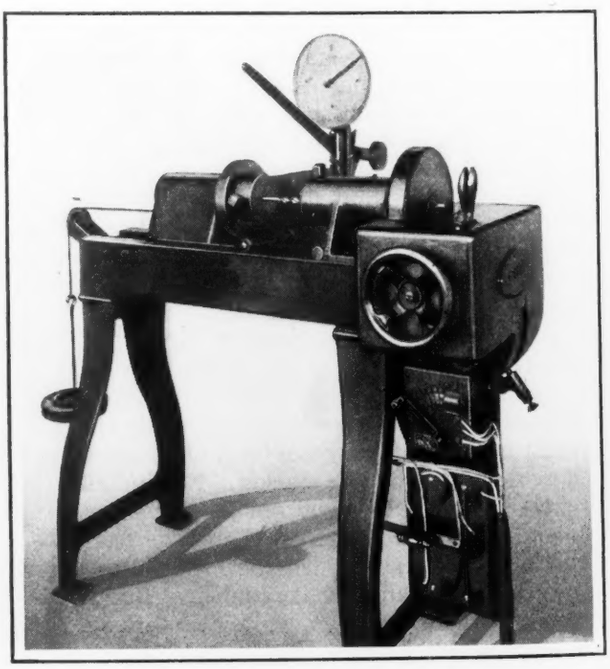


Fig. 3. Type of Machine Employed for Determining the Torsional Strength of Wire Drills

With the specimen gripped in the chucks, the motor is started up and operated until the specimen has been twisted into two pieces. The load on the specimen increases gradually as the weight is moved automatically along the scale beam. This machine has a rating of 60,000 inch-pounds. It is operated at the slower speeds for specimens of the largest diameter.

Wire drills and the raw materials from which they are made are checked for torsional strength in the simpler machine illustrated in Fig. 3. The dial gives the torsional moment in inch-pounds at the breaking points. This machine has a capacity of 3000 inch-pounds.

Determining the Cutting Capacity of Tools

The cutting properties of finished tools, such as drills, reamers, taps, and end-mills, are tried out in the Olsen universal efficiency-testing machine shown in Fig. 5 and in the foreground of the heading illustration. The graphic chart of this machine indicates the amount of torque on the tool at any point in the operation, and provides a means of determining the proper steels to be used in cutting various metals; the different tool shapes that give best performances; and the most efficient cutting speeds to be employed. By the use of this equipment, the possibility of new materials, such as tungsten-carbide alloys, can be conveniently investigated.

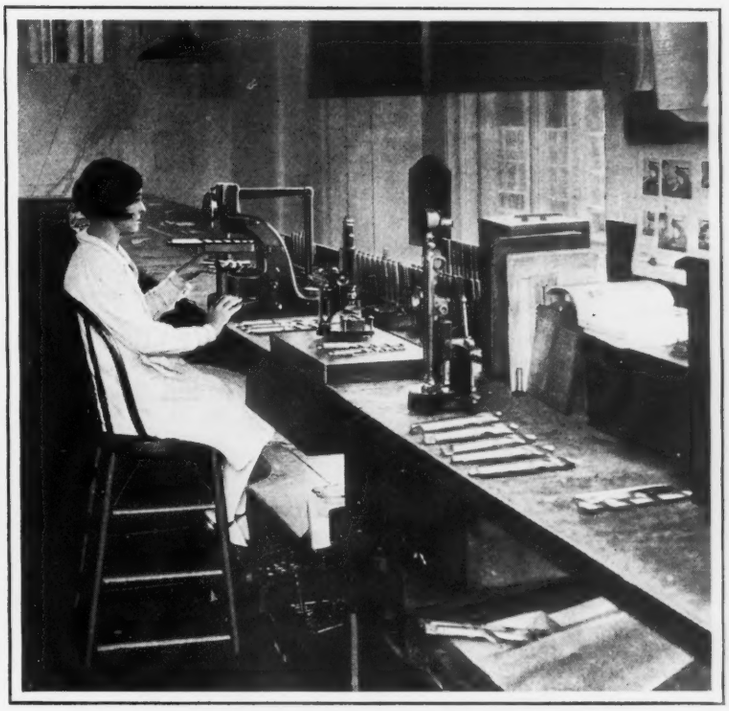


Fig. 4. General View of One of the Inspection Benches

Fig. 5 shows the machine being used in determining the properties of a long oil-hole drill of the type having two holes running the full length through which oil is forced to the cutting edges. Dial *B* indicates the amount of pressure developed on the oil, which is delivered to the drill by a small pump. Dial *C* shows the pressure, in pounds, exerted on the cutting end of the tool when the power feed of the machine is being employed, while dial *D* on the tailstock tells the amount of pressure on the tool point when the work is fed by gravity to the tool through the use of the weights seen beneath the headstock in Fig. 6. Counter *E*, Fig. 5, gives the total number of revolutions made by the tool in drilling to predetermined depths.

The weighing unit of this machine for determining the torque is in the form of a pendulum mounted on ball bearings. Interchangeable weights

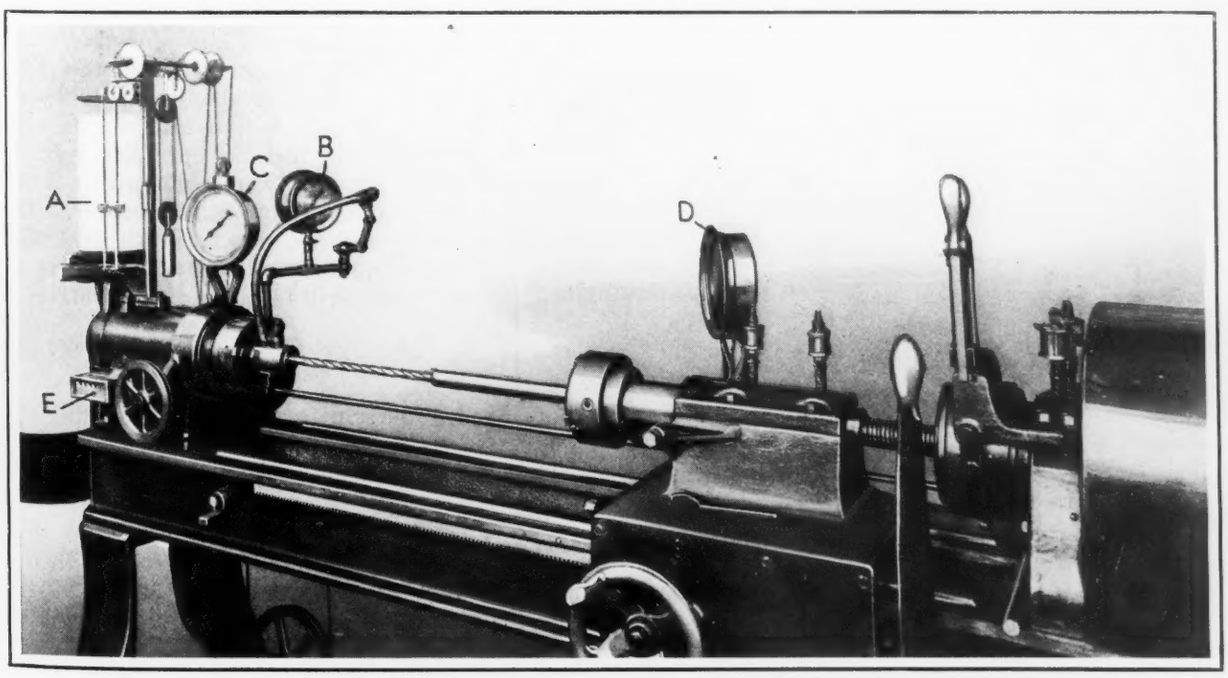


Fig. 5. Determining the Cutting Efficiency of an Oil-hole Drill for Deep Drilling

permit of varying the capacity from 10 to 2000 inch-pounds. Power carriage feeds range from 0.0025 to 0.040 inch per revolution of the spindle, and spindle speeds from 36 to 1070 revolutions per minute.

Fig. 6 illustrates the set-up used on the same machine to determine the metal-removing capacity of different kinds of files. On the tailstock spindle is mounted a cylinder *A* having about twenty slots around the outside in which are clamped pieces of bar stock of the material on which the files are to be tested. Each file is mounted, one at a time, on head *B*, and the test consists of revolving the stock pieces in cylinder *A* against the stationary file. The relative efficiency of the different files is determined by weighing the filings obtained after a given number of revolutions of cylinder *A*.

Weights *C* are employed to pull the stock pieces against the file with a predetermined pressure, wires connecting the shelf on which the weights are placed, with the tailstock of the machine. Four tests, at least, are performed on the files, since any one file might be either above or below the standard quality.

A somewhat similar arrangement is used in checking the possibilities of hacksaw blades.

Drill Endurance Tests

Both drilling machines seen at the right in the heading illustration are used for performing endurance tests on drills; Fig. 7 shows a close-up view of such a test. This is performed to determine the comparative qualities of, say, five drills of different kinds of steel or of different designs. About ten holes are drilled successively in solid steel with each drill, and the process is continued until the drill point starts to give out. In this manner, the average number of holes produced per grind of the drills and the average amount of metal removed can be determined. The points are reground for further trials, nine observations being taken on each drill.

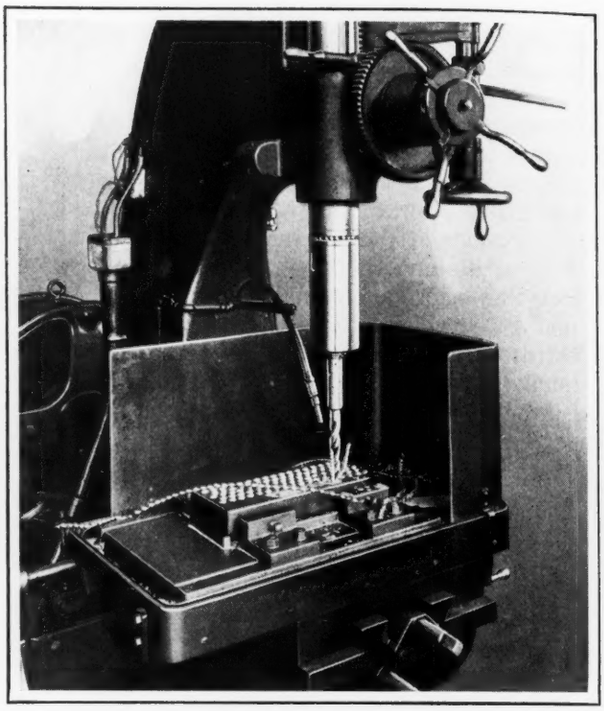


Fig. 7. Performing an Endurance Test on a Drill

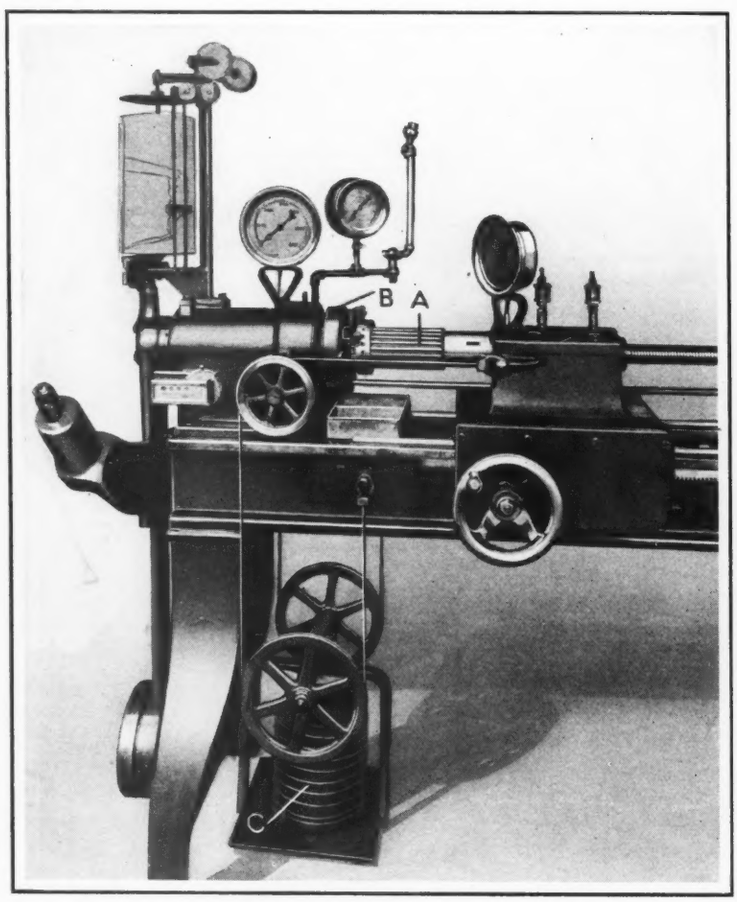


Fig. 6. Set-up Employed in Determining the Metal-removing Efficiency of a File

The particular machine shown in Fig. 7 is driven by a 20-horsepower motor. Spindle speeds are available from 40 to 600 revolutions per minute and feeds from 0.0075 to 0.100 inch per spindle revolution. The amount of power consumed by a drill is determined from an ammeter. This provides a check on whether a drill point is becoming too dull. Graphic charts are made of all drill tests for future reference.

Other Equipment of the Physical Testing Laboratory

In addition to the upright drilling machines referred to, several other machine tools are installed in the physical testing laboratory for investigating the performance of tools. For instance, there is a Brown & Sharpe automatic screw machine which is employed for performing endurance tests on wire drills used horizontally. This machine is equipped with a special high-speed spindle, the speeds of which are controllable through a Reeves variable-

speed transmission. A tachometer indicates the speed of the countershaft.

A milling machine is employed for checking the performance of milling cutters and for obtaining the chips required in the analyses made by the chemical laboratory. An engine lathe, two small drilling machines, several floor-stand grinders, and a drill-point grinder complete the machine equipment.

Fig. 4 shows a view along one bench, on which a Rockwell hardness tester, Scleroscope, microscope, and various other instruments are placed for the inspection of tools. A Bausch & Lomb contour measuring projector in a room adjacent to the chemical laboratory permits the minute observation of threaded parts and various other shapes.

* * *

INDUSTRIAL MACHINERY EXPORTS INCREASE

The export trade in industrial machinery has moved steadily upward for some time. Statistics for 1929, up to October 31—the last month for which figures are available—show exports to a value of $217,500,000, which exceeds by $11,000,000 the entire industrial machinery exports for the whole year of 1928.

Foreign sales of American metal-working machinery have continued to hold previous gains, and for the first ten months of 1929 show an increase of nearly 28 per cent over the corresponding period of 1928. According to the Industrial Machinery Division of the Department of Commerce, the increased exports of machine tools and metal-working machinery have been fairly general all along the line, but have been particularly notable in the case of lathes, automatic screw machines, milling machines, gear-cutting machines, and sheet metal working machines, forging machinery, foundry and molding equipment, and pneumatic portable tools. Exports of vertical boring mills, chucking machines, and rolling mill machinery have more than doubled.

The value of metal-working machinery exported during October, 1929, was $3,338,000 and the total exports for the first ten months of 1929 were valued at $34,186,000 as compared with $26,739,000 during the first ten months of 1928.

* * *

To supply the cooling water for a General Electric turbine generator to be installed in the Ford Plant at Fordson, Mich., a tunnel 3 1/2 miles long and 15 feet in diameter will be constructed. This tunnel will deliver 600,000,000 gallons of water every twenty-four hours.

Building Aircraft Engines

In an article to be published in March MACHINERY, describing the entry of the Continental Motors Corporation into the aviation field through its subsidiary, the Continental Aircraft Engine Co., typical machine tools recently installed for the manufacture of Continental air-cooled radial-type engines will be illustrated and some of the outstanding operations in the machining of the Continental seven-cylinder engine will be described. This engine has a rating of 165 horsepower at 2000 revolutions per minute. Standard machine tools are used throughout the plant to provide for the flexibility that may be required should other types of engines be brought out in the future, and to permit of changing the manufacturing methods should it prove desirable to do so. Of course, automatics, tooled up for operation on a quantity production basis, are employed for a variety of parts.

WHY WORRY ABOUT THE MACHINE AGE?

In an address before the American Mining Congress at Washington, F. A. Merrick, president of the Westinghouse Electric & Mfg. Co., pointed out the fallacy of an idea that has been current for over a century and is still held by many people today, to the effect that the use of labor-saving machinery tends to decrease opportunities for employment and to reduce the wages of workers. The reason why there have been so many erroneous ideas on this subject is that most people believe that machines which reduce the amount of labor needed to perform a certain operation must also reduce the total amount of labor needed in industry. However, it is obvious to anyone who has the power of observation that with the increasing use of machinery and labor-saving devices during the last fifty years, the demand for labor has greatly increased; and the wages of labor, whether measured in dollars and cents or in purchasing power, have also greatly increased.

Probably no industry employs labor-saving machinery to a greater extent than the automobile industry. What has been the result? It has become possible to produce automobiles at a price that is within the range of more than twenty million families in the United States. Hence, we are building automobiles at the rate of five million a year, employing some 800,000 workers directly in the making of automobiles and parts, and altogether, some 4,000,000 workers, including the occupations created by the automobile industry, such as road-building, the supplying of oil and gasoline, and in garage and service station work.

The perfected automobiles of today, if produced by the simple machinery and hand operations of thirty years ago, might cost $10,000 apiece. The demand for such high-priced cars would be very small, and the number of people employed in the industry building them would be correspondingly insignificant. Hence, it is labor-saving machinery and the lower prices that this type of machinery makes possible that have created employment for some four million people; and counting the families of these workers, it may be said that some fifteen or twenty million people depend directly upon the automobile industry for their support.

* * *

As an indication of the lasting qualities of wrought iron, it is of interest to note that decorative work made from this material in the San Jose Mission in Texas, built in 1701, is still in an excellent state of preservation.

What MACHINERY'S Readers Think

A Department for the Interchange of Ideas on Problems of Management, Foremanship, and Employe Relations

FAMILIARIZING DESIGNERS AND DRAFTSMEN WITH SPECIALIZED WORK

In almost every large concern, there are a few men who are experienced in the design of certain highly specialized units or parts. The proper procedure in handling design work of this kind, which is generally known only to these few men, has necessarily been developed through years of experience in solving the problems involved.

In the aircraft industry, this class of work might be the design of floats for seaplanes. In the machine-building industry, the design of bearings for heavy machines may be a specialized line of work allotted to a few men only. Such work may not necessarily occupy the full time of these men. On the other hand, the number of men available for this kind of work may have been reduced to a point where rush orders cannot be handled readily.

A practical way to guard against such contingencies is to have one of the men experienced in each class of special work conduct informal discussions with a small picked group of draftsmen. He can then explain to them the methods of handling the special work. These lectures are best conducted with a blackboard, an air of informality, and in an atmosphere of free discussion.

WILLIAM J. KANE

SHOULD WAGES BE BASED UPON DEPENDABILITY OR PRODUCTION?

The problem of how to play fair with the competent man who does not have a chance to attract attention on production work has been given serious consideration by many executives. The argument is often advanced that the production and not the dependability of the worker is the important factor. Of course, production is necessary, but the number of pieces a man turns out does not always show how much he actually earns for the company.

The unfortunate condition which exists in many plants is that salaries are increased either through personal preference, length of service, or in proportion to the aggressiveness of the employe and his productivity. None of these factors provides a fair basis for setting wage rates. The writer's personal opinion is that salaries should be based solely on accomplishment, and that accomplishment should be understood to include not only quantity but quality of production.

Dependability, also, should be recompensed. Looking at the problem from another angle, every man should be penalized for the amount of supervision he requires. In other words, the less supervision a man requires the more he is worth to the company. The man who can be depended upon to do a job right with the minimum amount of supervision is an asset to any company. Production is important, of course, but quality as well as quantity should be considered. It is the net amount of acceptable work produced with a minimum amount of supervision that really counts.

HARRY KAUFMAN

INSTRUCTING OPERATORS OF NEW MACHINES

If a buyer, on purchasing a new machine, requests the builder to teach the mechanic who is to operate the machine how to care for an occasional breakdown, much idle time may be eliminated. By having the operator trained to make occasional repairs, it will not be necessary for the machine to stand idle while waiting for a service man. This is an important item, especially when it is necessary for the service man to travel a long distance. The required instructions can be given to the operator at the time the new machine is installed.

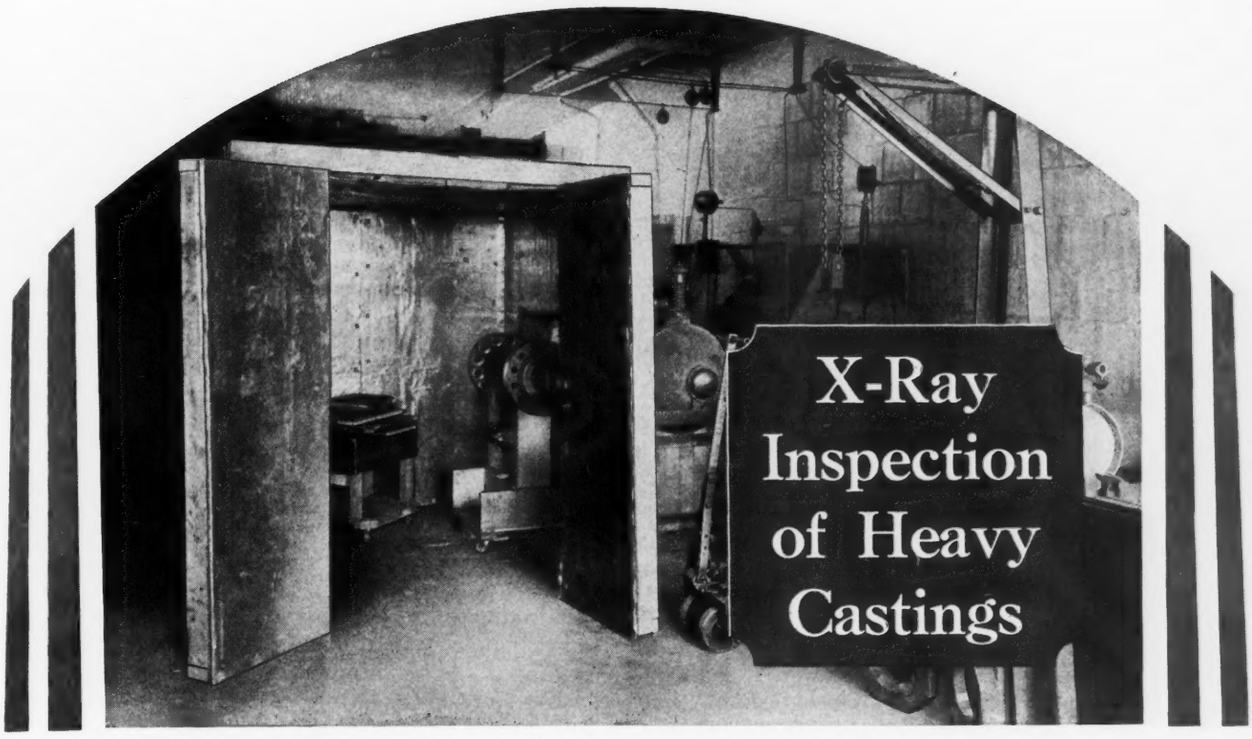
Also, if machine builders would add to their regular instruction books a brief treatise on the making of minor repairs, they would lessen their service expenses considerably. On certain types of machines, breakdowns result from their operation by men who are not familiar with their use. In such cases, the foreman of the shop should restrict the use of the machine to the regular operator and one or two men who serve as understudies and who should be able to run the machine in the absence of the regular operator. MORTON SCHWAM

PRACTICAL CHARTS FOR SHOP USE

Charts and graphs, when properly made, are a valuable aid to men both in the shop and in the drafting-room. Facts expressed in picture form impress the mind much more vividly than those expressed in dry words. However, when the picture attempts to cover too wide a field it becomes complicated and confusing and so defeats its own purpose. For this reason many charts sent to the shop fail in their purpose simply because an attempt has been made to include too many factors.

The simpler the chart, the better. In this connection it might be well to note that the substitution of straight lines for curved lines whenever possible is desirable. This can often be done by employing logarithmic spacing for the ordinates and mantissas. In most cases it is better to have two simple charts for the solution of a problem than to have one chart containing the complete solution.

B. J. STERN



X-Ray Inspection of Heavy Castings

How Pipe Fittings Weighing up to Three Tons Each, with Sections up to Three Inches Thick, Were Inspected on the Job

By ANCEL ST. JOHN and HERBERT R. ISENBURGER

IN a former article in MACHINERY, "X-Ray Inspection in the Machine Shop," published in May, 1928, the authors outlined some of the applications of X-ray inspection in the industrial field, showing several examples of this class of work as carried out in the laboratory of Dr. Ancel St. John at Long Island City, N. Y. The purpose of the present article is to augment the information formerly given and to describe how X-ray inspection has been applied to heavy steel casting pipe fittings for high-pressure service.

In order to be sure of having sound steel castings for their 1200-pound pressure steam power plant, the owners of the power station and their engineers decided to have these castings inspected by means of the X-ray before placing them in service. As several of the fittings weighed more than three tons each, it was more convenient to inspect them at the plant where they were to be installed rather than to have them sent for inspection to the laboratory. Accordingly, a high potential power plant was temporarily equipped at a suitable location near the steam plant. The X-ray equipment used was moved from the Long Island City laboratory mentioned, to this inspection plant, and was later returned to the home laboratory. This is the first time in the history of industry that X-ray equipment powerful enough to examine steel 3 inches thick has been used as a transportable unit.

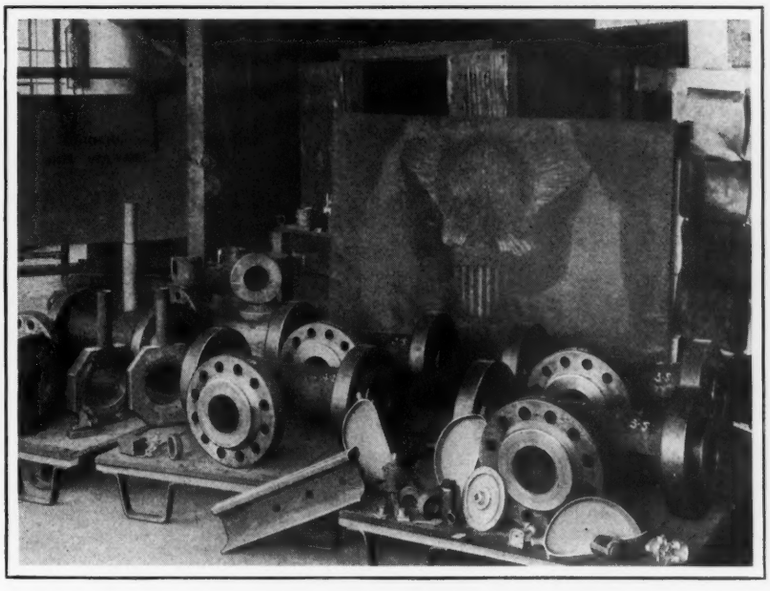


Fig. 1. A Collection of Objects Tested and Inspected by X-rays

General Description of the X-Ray Equipment Used

The set-up in the home laboratory shortly before the temporary removal of the equipment is shown in the heading illustration. A number of

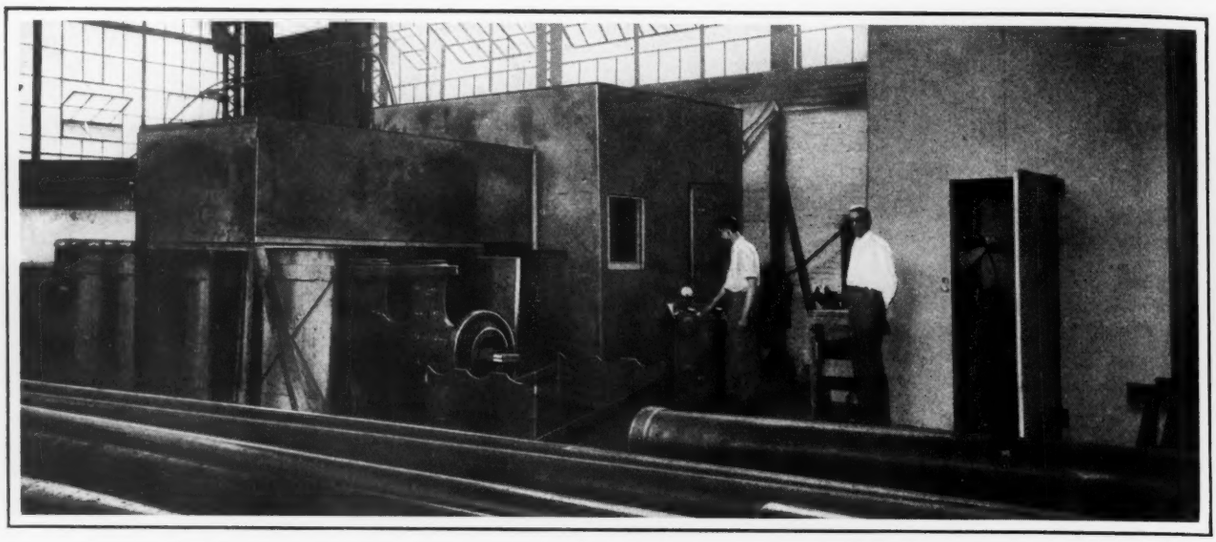


Fig. 2. X-ray Equipment Temporarily Installed for the Inspection of Heavy Steel Castings

the objects regularly inspected by the equipment, ranging from old oil paintings to 6-inch steel casting T-fittings, are shown in Fig. 1.

Fig. 2 shows the temporary installation. The X-ray tube is placed in a lead-lined box within a sheet-iron case directly over the casting to be inspected, as indicated in the illustration. The photographic films are placed in special cassettes on a carrier which may be seen projecting from the end of the casting. The X-rays are thus passed through the wall and make a shadow picture which shows the location and nature of any serious defects. During exposure, the casting is surrounded by a lead-covered housing to prevent the X-rays from passing out into the room. The casting and housing travel along tracks under the tube.

A 200,000-volt direct current is produced by special transformers and rectifiers within a sheet-iron room just behind the control stand, as shown. The high potential equipment is thus completely surrounded by a grounded metal shield. The high potential power plant within the sheet-metal housing is shown in Fig. 3.

Fig. 4 shows a large manifold mounted for examination at the regions indicated by white stripes. In this case, the lead housing is rolled back out of the way, while in Fig. 5 it is shown in position for an exposure. For the complete examination of a fitting of this size, approximately 125 X-ray pictures are required, consuming about 30 hours of actual exposure time and at least 10 hours additional for arranging the casting and placing the films. The development of the films and the loading of the cassettes are done while other exposures are in progress. Smaller fittings require correspondingly shorter time. For instance, the 6-inch tees shown in Fig. 1 were examined in about 5 hours each.

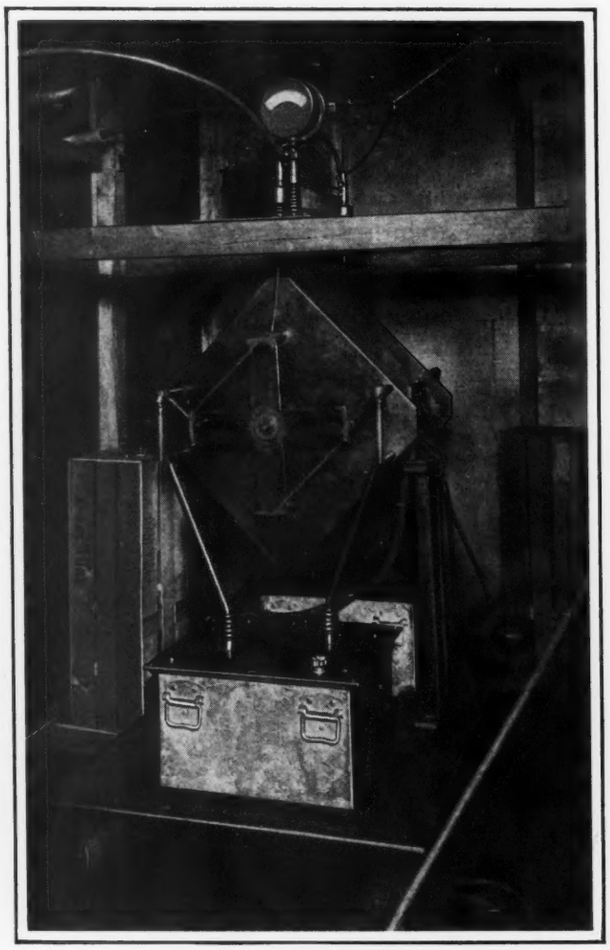


Fig. 3. The Power Plant for Producing the 200,000-volt Current Required in X-ray Examination of Heavy Castings

What the X-Ray Picture Reveals

Very few X-ray pictures of sound steel have been published, probably because they show nothing of special interest. Fig. 6 shows a picture of a perfect steel casting examined on the job. The rectangular dark patch with the number 3-5 is a lead marker placed on the casting which identifies the area to be examined. The parallel bands at the lower part of the picture are screw threads cut on the inner surface of the casting. The light spot in the lower right-hand corner is not a de-

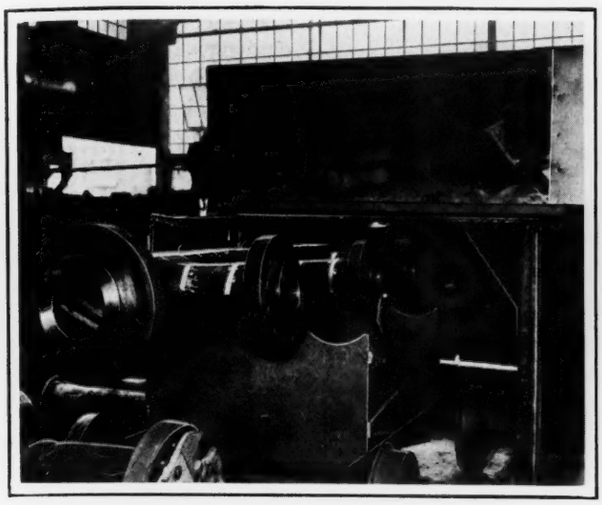


Fig. 4. A 7000-pound Header Set up for X-ray Inspection at the Places Indicated by White Stripes

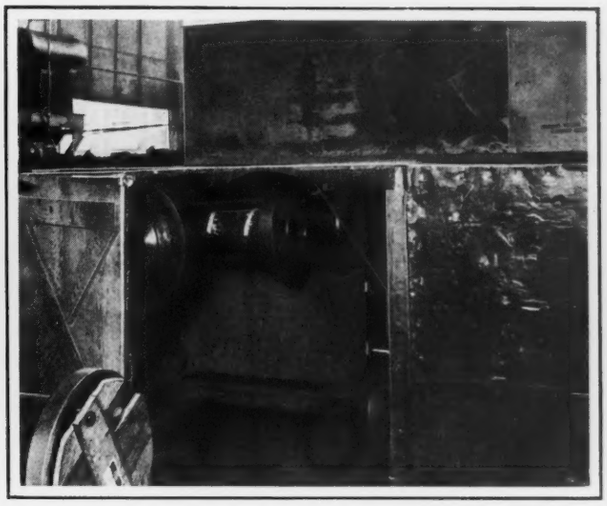


Fig. 5. The Fitting Shown in Fig. 4 in Position Inside the Lead Housing Beneath the X-ray Tube

fect, but is the inner end of a hole drilled through the wall.

By using lead markers as indicated, each picture carries its identification, and there is no danger of mistakes. The lead markers are held in place by the adhesive tape strips shown in Figs. 4 and 5.

X-ray tests confirmed by cutting a section of the casting and by other means of examination indicate that the undesirable internal conditions in castings fall into relatively few classes, all of which are traceable to definite and simple causes. Most of these causes, if not all of them, can be eliminated by proper foundry practice. Experience shows that when defects which repeatedly show up in the castings have been corrected by making the required changes in foundry methods, they tend to stay corrected. It is thus possible, by the aid of X-ray examinations and the conclusions drawn from them, to eliminate from 75 to 90 per cent of the more important defects in castings as produced by a given foundry. Much valuable information about X-ray inspection is contained in "Recommended Practice for Radiographic Testing of Metal Castings," recently published by the American Society for Testing Materials, and known as recommended practice E 15-29. [Copies of this pamphlet may be obtained by addressing Herbert R. Isenburger, 505 Fifth Ave., New York City.]

Principal Defects Revealed by X-Ray Examination

The principal undesirable conditions in steel castings revealed by an X-ray examination are as

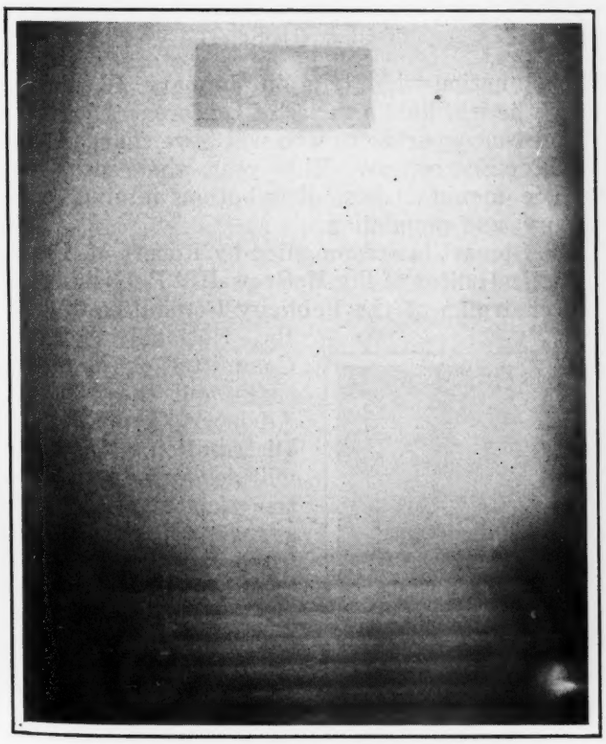


Fig. 6. Exograph of a Perfect Steel Casting (Half Size)

Fig. 7. Double Exposure of a Sand Pocket (Half Size)

follows: (1) Gas slag and sand pockets due to loose dirt in the mold; (2) gas cavities due to imperfectly deoxidized metal; (3) sand inclusions due to cutting of the mold or the runners; (4) pipe or primary shrinkage caused by failure of the risers to function as indicated; (5) secondary pipes caused by flow of viscous metal through constricted channels in the casting during the final stages of solidification; (6) shrinkage cracks starting from a sinus-like cavity developed during cooling; and (7) rupture developed during hydrostatic test.

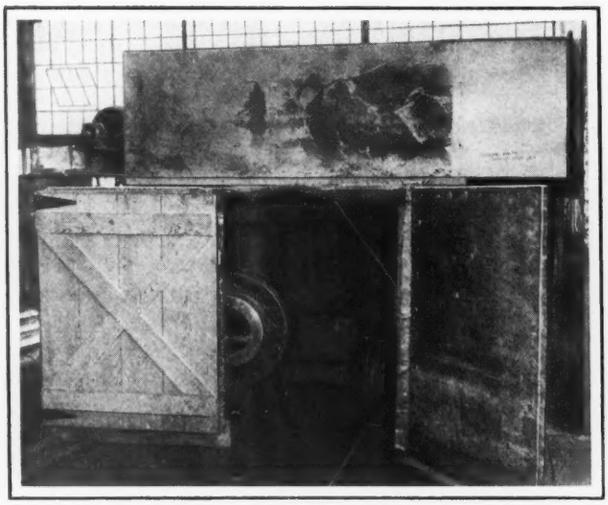


Fig. 8. Same Casting as in Fig. 4 Set up on Another Stand to X-ray the Places Between the Nozzles

Examples of Defective Castings Shown by X-Ray Pictures

The accompanying illustrations show how some of the defects enumerated may be seen on the X-ray picture. Fig. 7 is a double exposure of a region containing a fairly large sand inclusion. Between the exposures, the casting was shifted slightly without changing the position of the film within it. The shadows of the number marker were displaced 5/8 inch; the shadows of the various parts of the inclusion were displaced 9/16 inch or more; and the small spot below the marker, 3/8 inch. This spot was on the inner surface, while the marker was on the outside. By estimating the relative amount of displacement of the number marker, of the small spot, and of the sand inclusion, it is possible to estimate the location of the sand inclusion within the casting. In this case, for example, the inclusion lies just under the outer surface and does not penetrate more than 1/4 inch through the wall; hence it does not cause any serious defect in the casting.

Fig. 9 shows primary pipe or shrinkage cavities extending through the flange from the heavy section at the junction of flange and wall of a small valve body. A gas pocket, a sinus-like cavity, and extended secondary pipe or shrinkage cracks appear in Fig. 10, taken from the main wall of a 6-inch T-fitting. Fig. 11 is a picture of a 3-inch ell which shows a clear-cut crack starting from a small inclusion and caused by a hydrostatic test which the casting had passed successfully.

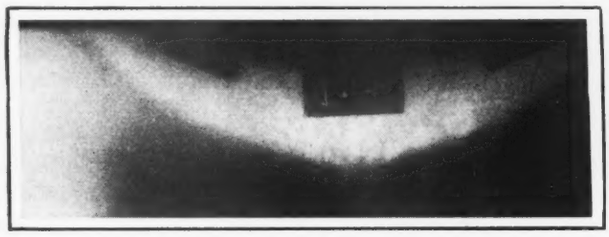


Fig. 9. Shrinkage Cavity Extending through the Flange of a Small Valve Body (Half Size)

Fig. 10. Gas Pocket and Shrinkage Cracks in a Six-inch T-fitting (Half Size)

Fig. 11. X-ray Picture of a Three-inch Ell Showing Crack (Full Size)

* * *

THE 1930 CENSUS OF MANUFACTURES

The director of the Census Bureau at Washington, D. C., Dr. W. M. Steuart, started on a six weeks' nation-wide trip on January 16, during which he will hold a series of conferences with the 600 census supervisors who will have charge of the forthcoming census. This year, the census will include manufactures, distribution, mining, agriculture, and population.

Dr. Steuart is accompanied by Robert M. Davis, statistical editor of the McGraw-Hill Publishing Co. and chairman of the Publicity Committee of both the National Advisory Committee on Manufactures and the National Advisory Committee on Distribution. Mr. Davis will deliver addresses on the practical use of census data on manufactures and distribution to groups of manufacturers and distributors at meetings under the auspices of the local Chambers of Commerce and other trade and industrial organizations.

Electric Precision Gage of Great Accuracy

With an Amplification Factor of 10,000, This Gage, Independent of the Human Touch, Makes Possible Measurements to 0.00005 Inch

THE remarkable development of interchangeable manufacture during the last few years has created a demand for more accurate gages and gaging devices. Many types of amplifying gages are now in use, but usually those having high precision are either too slow in operation for quantity inspection purposes or require skilled operators. Another objection to this type of gage is the fact that the mechanism usually requires frequent repairs or adjustment. To overcome these objections, the electric gage recently described in the *General Electric Review* was developed. This gage meets the demands for an accurate gaging device that has a minimum of moving parts and that will permit routine gaging operations to be conducted with great rapidity.

Gage May be Used for Both Inside and Outside Measuring

This type of gage was originally designed for measuring the bore of a hole, but by making slight changes in the gaging head it can be used for external measurements also. During a period of three months, as many as 59,000 holes were tested, and yet the gage showed little indication of wear.

Fig. 1. Electric Gage in Operation on Quantity Production Work

In Fig. 1 is shown the electric gage set up for measuring production parts. The needle of the ammeter, which is the lower instrument in the illustration, deflects the full distance on the dial for a variation in work diameter of 0.0005 inch. One ten-thousandth inch variation will deflect the needle one inch. It is easy to estimate quickly half-inch movements of the needle and thus to measure accurately to 0.00005 inch.

The electric gage operates entirely independently of the sense of human touch. This is necessary in the use of "Go" and "Not Go" plug gages. Furthermore, a skilled inspector is not required for this gage, as its operation is extremely simple, and quantity production inspection can be carried on at high speed, with much less fatigue than is caused by the use of the plug gage for internal inspection.

Principles of Design of Electric Gage

The gage is operated by the changing of the reluctance of a balanced, differential, alternating-current circuit, as indicated in the upper part of Fig. 2, which, in turn, operates a direct-current ammeter through a small rectifier. A smooth, rounded diamond point, mounted on a single lever arm, changes the reluctance of the coils in the electrical circuit in proportion to the differences in diameter of the piece of material being gaged. Compression springs, as shown in the lower part of Fig. 2, hold the diamond point in contact with the surface under inspection. A diamond point is used because thousands of pieces can be inspected without the point showing any wear. Two sapphire bearing surfaces are used in connection with the diamond point when inside diameter measurements are required, making a three-point contact on the measured surface. The diamond, the hardest of all substances, is rated 10 in hardness and the sapphire is rated 9.

Practical Application of the Electric Gage

Electric gage inspection places no mental strain on the operator, because the ammeter needle immediately registers the required information—whether a cylindrical hole is over or under size, out of round, or tapered, or whether it has irregularities. For calibrating the electric gage to inspect the cylindrical holes in the pieces shown in Fig. 1, two master gages were used—one a 0.7509-inch gage for the minimum dimension, and the other a 0.7512-inch gage for the maximum dimension. These two limits, when marked on the ammeter scale, are 3 inches apart, and all pieces must fall within these limits in order to pass inspection.

Rotating the piece under inspection will show how much it is out of round. If the piece is perfectly round, the ammeter needle will remain stationary, but if the piece is out of round as little as 0.0001 inch, the needle will move back and forth 1 inch on the ammeter scale.

To vary the precision required, the sensitivity of the electric gage can be changed by working the lever arm in a larger or smaller air gap or by changing the location of the diamond point on the lever arm. Flat surfaces and external diameters can also be inspected and measured in a similar manner.

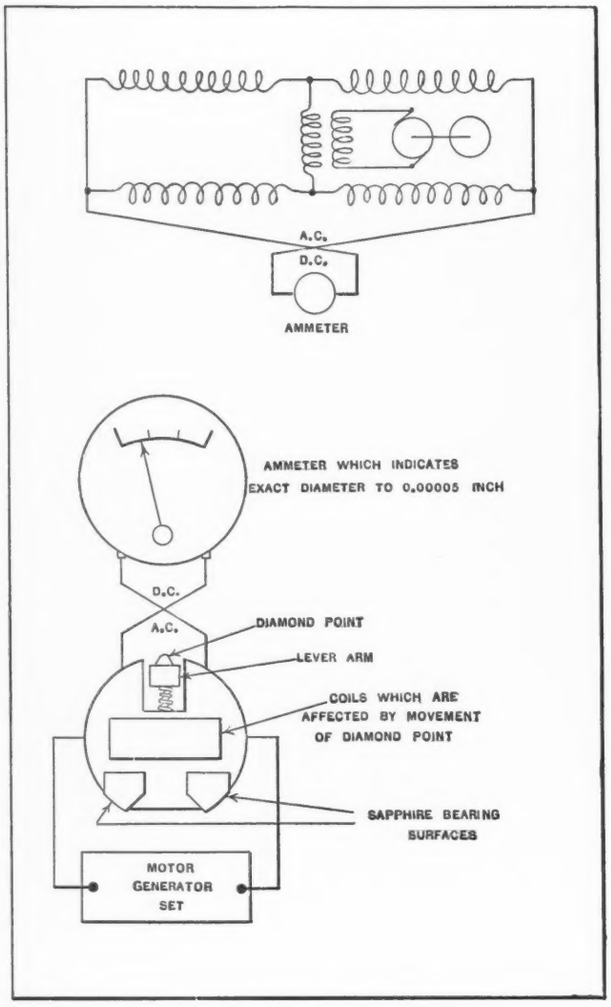


Fig. 2. Connection Diagram and Schematic Representation of Electric Gage

A small 500-cycle motor-generator set, operating on a shop supply circuit, is employed to supply the five watts of energy necessary to operate the electric gage. Slight fluctuations in the shop voltage do not have any effect on the stability of the electric gage.

* * *

CHROMIUM-PLATED WOOD-PLANER KNIVES

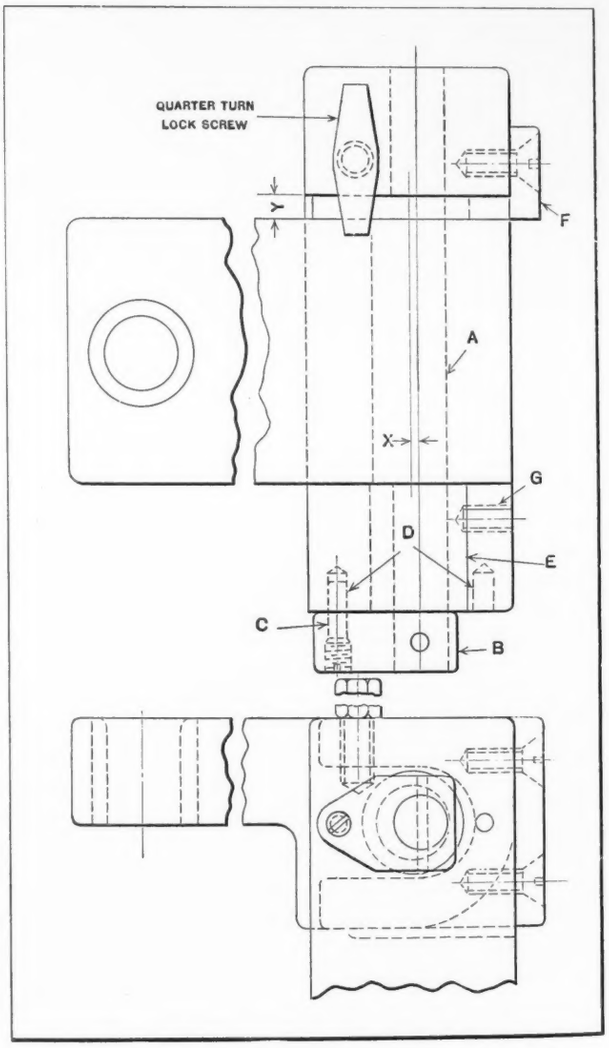
An interesting development in the manufacture of high-speed steel wood-planer knives has been announced by the Simonds Saw and Steel Co., Fitchburg, Mass. After considerable experimentation and research, this company has successfully developed a greatly improved wood-planer knife known as the "Chromium-plated Red Streak High-speed Steel Planer Knife." To test the value of the chromium-plated knife, it has been installed in plants throughout the country, and the fact has been established that it has a longer life than ordinary knives. Tests have shown that the new chromium-plated knife, operating on kiln-dried stock, has given 25 per cent longer life than the knives formerly used. It is also stated that it has given from 200 to 300 per cent longer time between jointings on green lumber.

SHIFTING JIG LEAF TO OBTAIN SEVERAL LOCATIONS FOR DRILL BUSHING

By J. E. FENNO

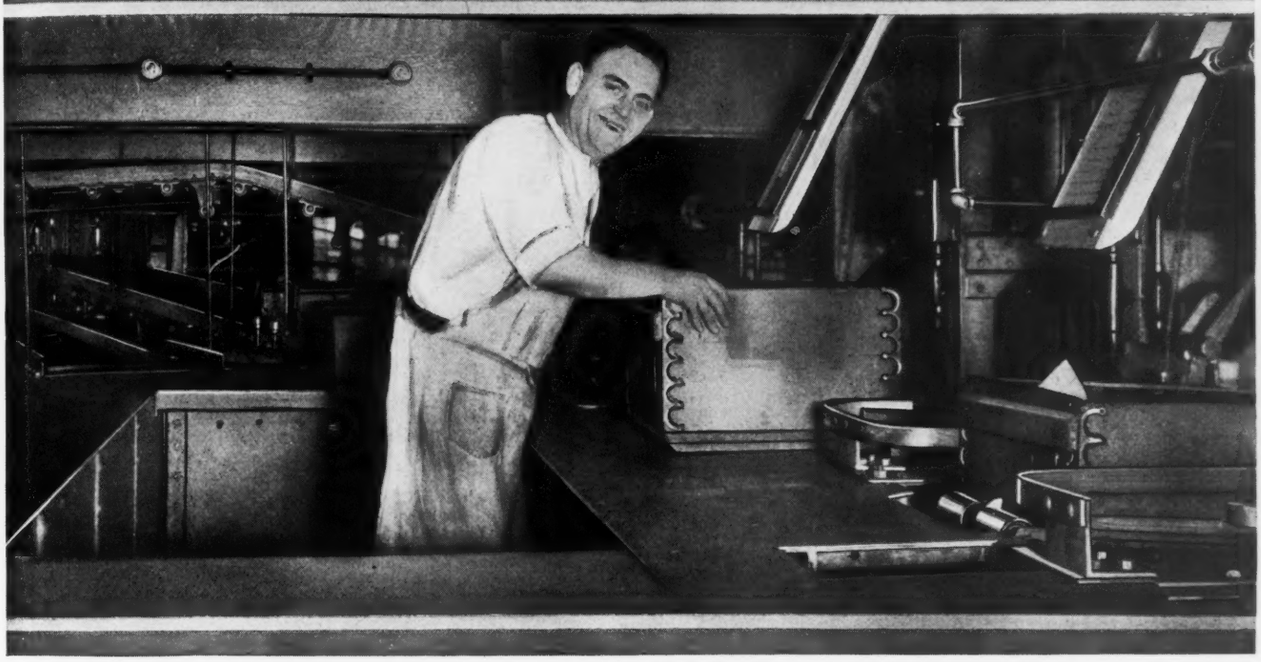
It is sometimes desirable to design a jig in which somewhat similar parts may be drilled, the only variation being in the location of the hole. The type of jig leaf shown can be shifted to provide four locations for the drill bushing, the shifting being done with a screwdriver only. The leaf is of the ordinary type, with the exception that the eccentric pin *A* replaces the usual straight pin. Bushing *E* facilitates the assembly of the eccentric pin.

The indexing block *B* is fastened with a dowel to the pin *A*. The locking screw *C* in the indexing block protrudes into one of the two holes *D*, depending on the required location of the drill bushing. The distance that the drill may be shifted with the eccentric pin is equal to two times *X*, and is governed by the eccentricity of the pin *A*. If it is required to shift the leaf a distance *Y* in a direction at right angles to that described, shim *F* is removed and fastened to the opposite side of the leaf, screw holes *G* being provided for this purpose.



Jig Leaf with Special Shifting Arrangement which Permits Holes to be Drilled in Different Locations

A Conveyor System that Handles Three Million Boxes a Year



Conveyor Installation which Serves Six Buildings Containing Over One Million Square Feet, or Twenty-four Acres, of Floor Space

By T. A. KEEFER, Factory Lay-out Department, National Cash Register Co.

CONVEYORS have proved so satisfactory in the plant of the National Cash Register Co., Dayton, Ohio, that over eight miles of them are now in use. Not only have they solved all previous problems of traffic congestion by eliminating the inter-departmental trucking of work, but they have also greatly increased production. With conveyors extending to the machines, work is always at hand to keep the machines running. Furthermore, the operators try to pass on finished work to the next operator as soon as possible, in order to be rid of it themselves, and this combined effort throughout the plant has a very favorable effect on the amount of work turned out.

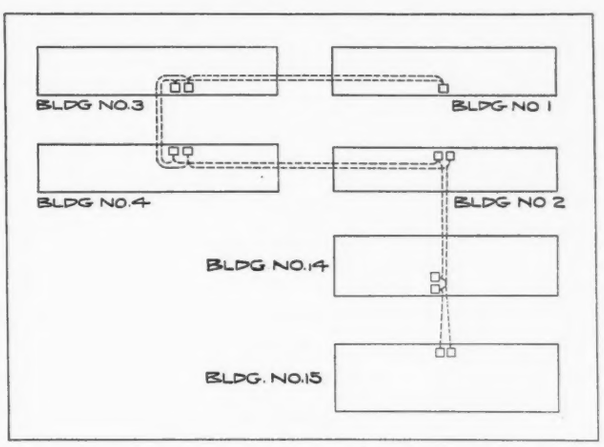


Fig. 1. Diagram of Six Buildings Served by a Conveyor which Handles Approximately 3,000,000 Work Boxes per Year

Another important advantage derived from the use of conveyors is the saving in floor space required for the storage of work in process. When trucks were largely used for the transportation of work, there were receiving and dispatching platforms in each department, and the tendency was for work to accumulate on these platforms and remain for several hours. Incoming work is now delivered direct to the machines, and finished work is immediately removed. The amount of capital tied up in inventories, has thus been reduced considerably.

One Conveyor System Serves Six Buildings

This article will describe one of the conveyor systems in the plant

which serves six buildings having a total floor space of more than 1,000,000 square feet. Five of the buildings are of six-story construction, while the remaining one, building No. 15, has but two floors. The location of these buildings with respect to each other can be seen by reference to Fig. 1.

Work can be readily sent by means of this conveyor system from any floor of one building to any floor of any other building. Between 2,500,000 and 3,000,000 boxes are handled by this system per year.

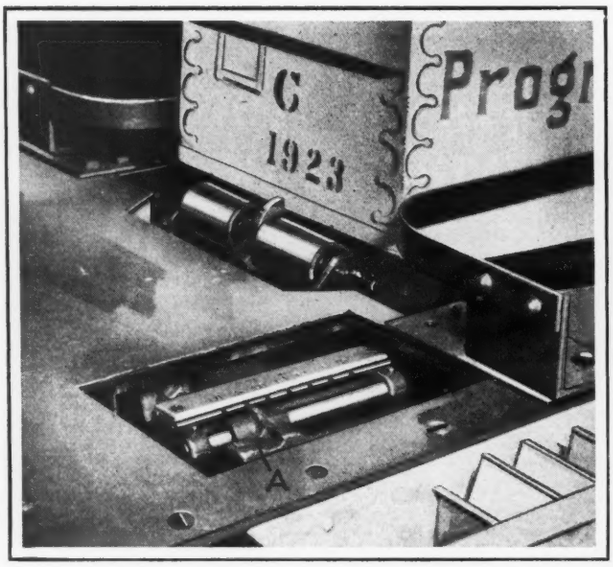


Fig. 2. Indicator Device of a Station Set to Send a Box to the Fourth Floor of the Same Building

Vertical Conveyors Extend from Basements to Top Floors

Two vertical conveyors in each building, with the exception of building No. 1, where there is only one, extend from the basement to the top floor. On the various floors, power-driven and gravity conveyors radiate from these vertical conveyors, delivering incoming work to the various departments of that floor, and taking outgoing work to the vertical conveyors. In some cases, work is taken on light trucks to and from the receiving and sending station of the floor.

On the third floor of each building, there is a transfer station from which work is sent over trunk conveyor lines to the other buildings. These trunk lines are represented diagrammatically by the dotted lines in Fig. 1. Building No. 15 contains the heat-treating department; a transfer station is not required in this building, as the work is delivered direct to the furnaces and the heat-treated work automatically leaves the building on two short vertical conveyors.

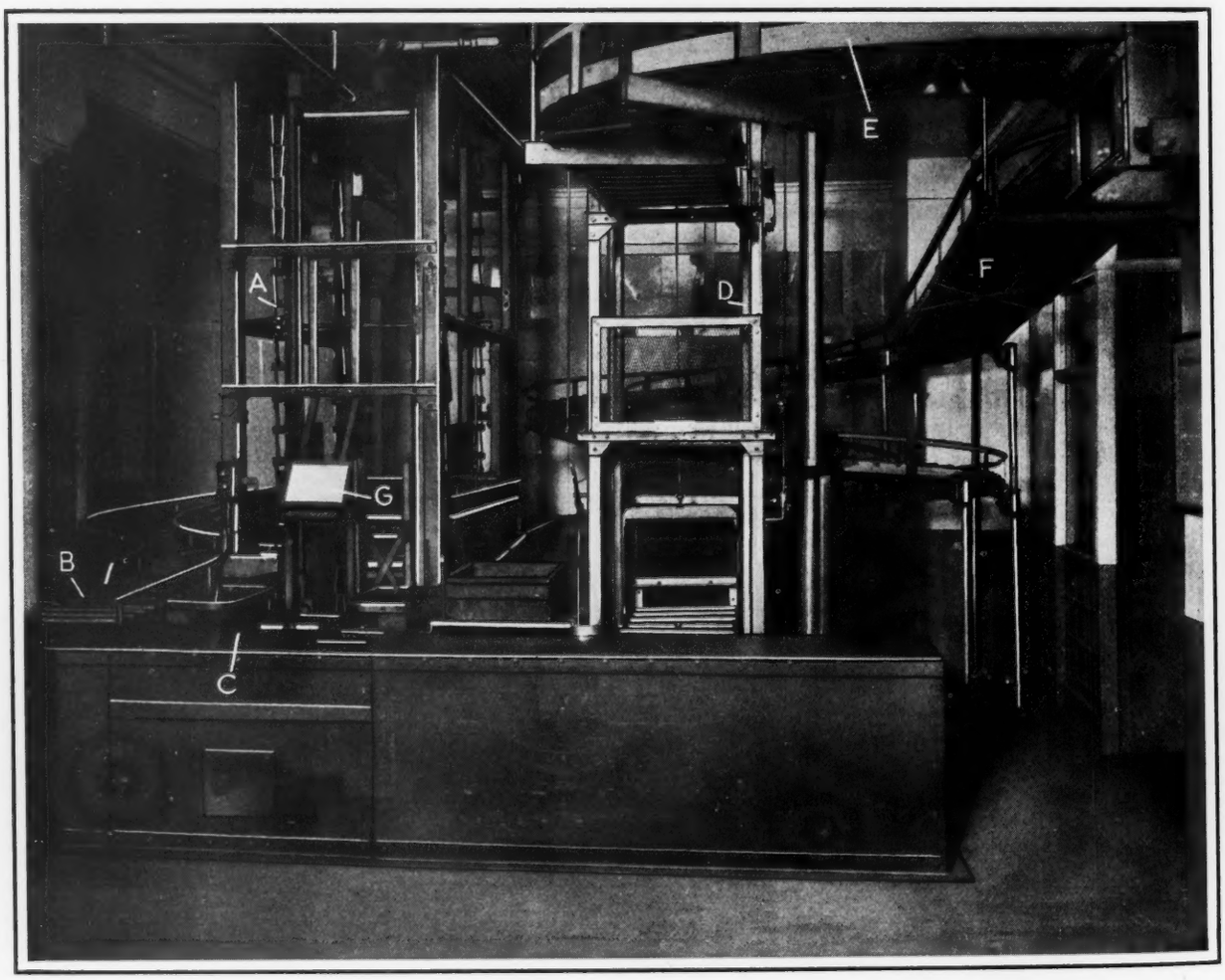


Fig. 3. A Floor Station where Incoming Work is Received and Outgoing Work is Dispatched

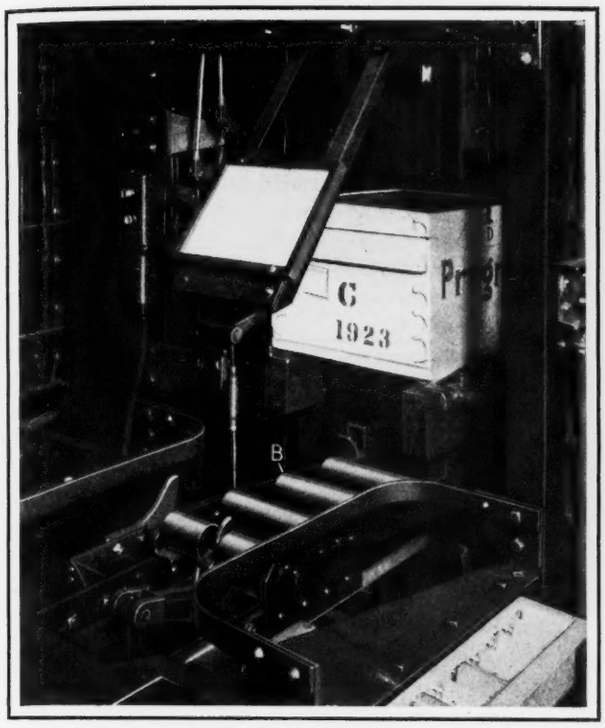


Fig. 4. Arrangement of Roller Platform Used in Loading the Boxes on the Vertical Conveyor Carriers

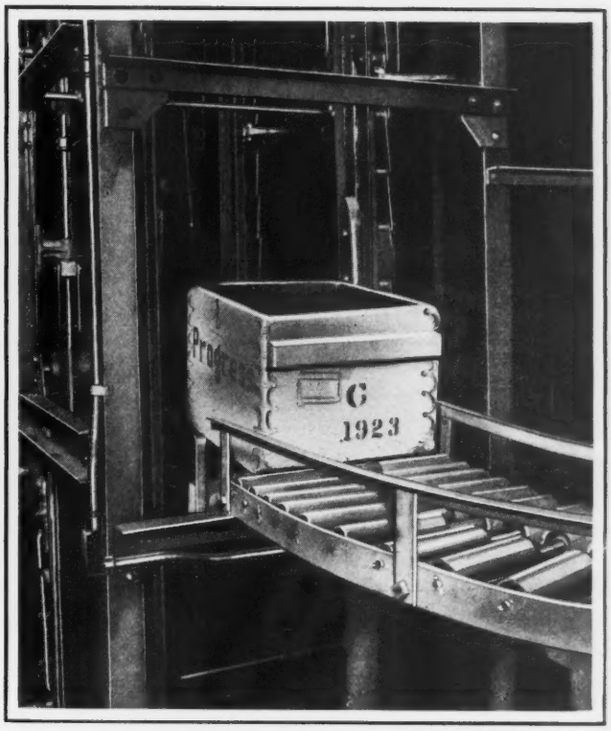


Fig. 5. Box Being Discharged from a Vertical Conveyor on Rolls that Carry it to the Station Table

Duties of the Station Men

Fig. 3 illustrates a floor station in building No. 1. At the left may be seen the vertical conveyor *A* which delivers all incoming work to this floor and carries away outgoing parts. Incoming boxes are automatically discharged at the back of the conveyor, and slide down the gravity track *B* to the top of table *C*. The man in charge of the station moves each box of incoming work over to the air hoist *D* near the right-hand end of the table, pushes it on the roller platform of this elevator, and operates a lever which causes the box to be elevated into line with the overhead gravity conveyor *E*. The box is automatically discharged on this conveyor, which carries it to the proper departments of the floor. Boxes of work not intended for de-

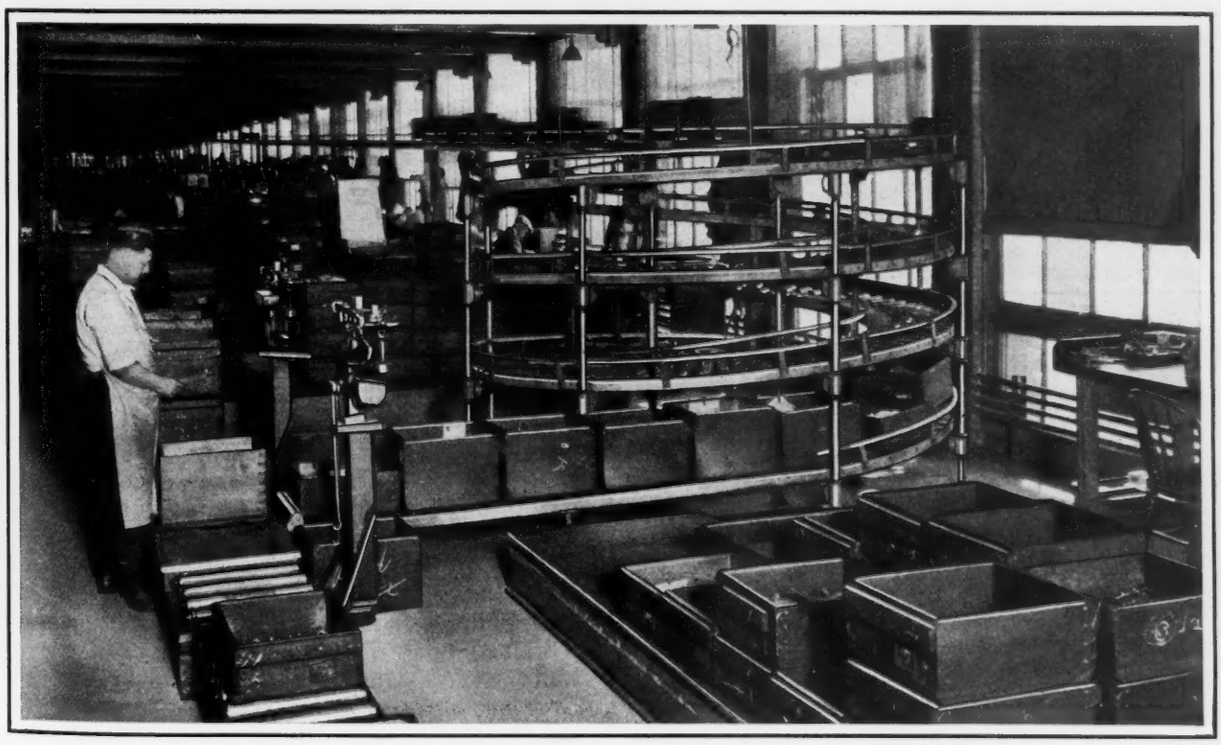


Fig. 6. Spiral Conveyor of the Type Employed in Certain Departments to Permit Temporary Storing of Work

livery to this floor simply pass up or down the vertical conveyor to their scheduled destinations.

Outgoing work passes over gravity conveyor *F*. In the boxes of outgoing work are small tags or cards which have been placed there by the machine operators or inspectors to indicate the plant department for which the work is intended. By glancing at the directory in the holder *G*, the station man can immediately determine whether the different boxes are merely to go to another floor of the same building or whether they should be sent to the transfer station to be dispatched to another building.

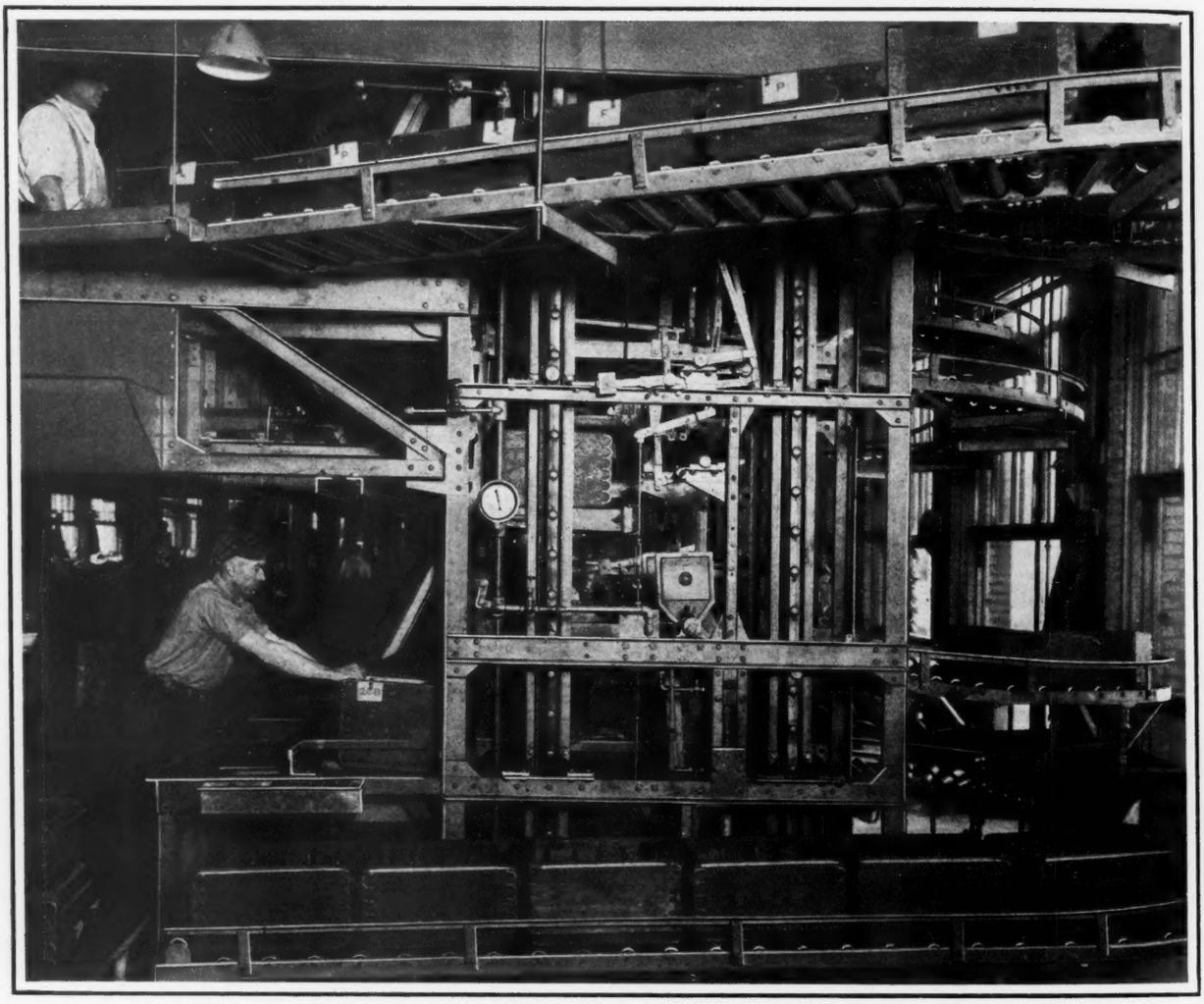


Fig. 7. Receiving and Sending Station on One of the Third Floors, with Transfer Station Above it from Which Work is Dispatched to Other Buildings

How the Boxes are Dispatched and Received

To dispatch a box, the station man sets an indicator *A*, Fig. 2, according to the floor where the box is to be discharged or to the transfer station of the same building. By so doing, a trigger arrangement on an unloading device at the floor indicated, is positioned by pneumatic means to discharge the box when it reaches that point. As the man then pushes the box on a short loading platform *B*, Fig. 4, a trigger at this shipping station is set to come in contact with a roller on the next carrier of the conveyor to reach the station. When this roller strikes the trip, loading platform *B* is automatically swung forward to bring the box of work into line with the vertically moving carrier. When the loading has been accomplished, the platform returns automatically to its normal position. The photograph reproduced in Fig. 4 was taken just after a box had been loaded on a carrier in this way.

At each floor station, there is a push-button switch, such as seen on the frame of the vertical conveyor in Fig. 3, which enables the station man to stop the operation of the vertical conveyor instantly should that be necessary.

When a box of work reaches the floor for which it is intended or the transfer station, it is discharged automatically on a roller platform, such as shown in Fig. 5, as a roller on the conveyor carrier strikes the tripping mechanism set by means of the indicator shown in Fig. 2. This action causes an unloading device to swivel and push the box from the carrier of the vertical conveyor. The work boxes are always loaded on the upward moving side of the vertical conveyors and discharged on the downward moving side. The loading mechanisms,

as well as the unloading devices, are actuated by compressed air at a pressure of 80 pounds per square inch.

Fig. 7 shows the arrangement of the receiving and sending station on the third floor, with the transfer station directly above it. The heading illustration shows a close-up view of a transfer station which is similar to an ordinary receiving and sending station, except that departmental and trunk conveyors radiate from it. Each transfer station man is responsible for sending outgoing work to the various buildings, and incoming work to the other buildings and to the different floors of his own building.

Counters are installed on the vertical conveyors to check the number of boxes handled each day. Approximately 96,000 boxes are kept on hand. They are made of 3/4-inch lumber and measure 15 inches in width by 18 inches in length. There are two sized boxes, 6 and 12 inches high, respectively.

The vertical conveyors run at a speed of about 60 feet per minute. The carriers are spaced 8 feet apart, which means that an average of 7 1/2 boxes can be conveyed per minute.

Conveyor Spirals Permit Temporary Storing of Boxes

In some departments, the gravity conveyors extending from the receiving or transfer stations terminate in a spiral, as shown in Fig. 6, to permit the temporary storing of a quantity of boxes in order to keep a small supply ahead of the machines or the inspectors.

Vertical air hoists, such as shown in Fig. 8, are provided in some departments for loading boxes directly on a trunk belt conveyor or on a belt conveyor leading to the sending station of the department. The boxes are merely loaded one at a time on a roller platform *A*, the rollers of which are inclined at an angle from the center to permit the boxes to slide off by themselves unless held in place on each side by a stop *B*.

After a man has placed a box on the roller platform, he operates a valve which permits air to pass into a cylinder so as to raise the platform to a level with the conveyor track *C*. Here, unless another box happens to be passing, stop *B* is immediately released, permitting the box to slide on the conveyor. Platform *A* then drops into the position shown. Should a box happen to be passing the vertical hoist or approaching it when the roller platform is raised, stop *B* would remain locked to hold the hoisted box on the platform until the conveyor track became clear. Vertical hoists of this type are spaced as close as 40 feet apart in some departments, so that the men will not have to walk far in sending away work.

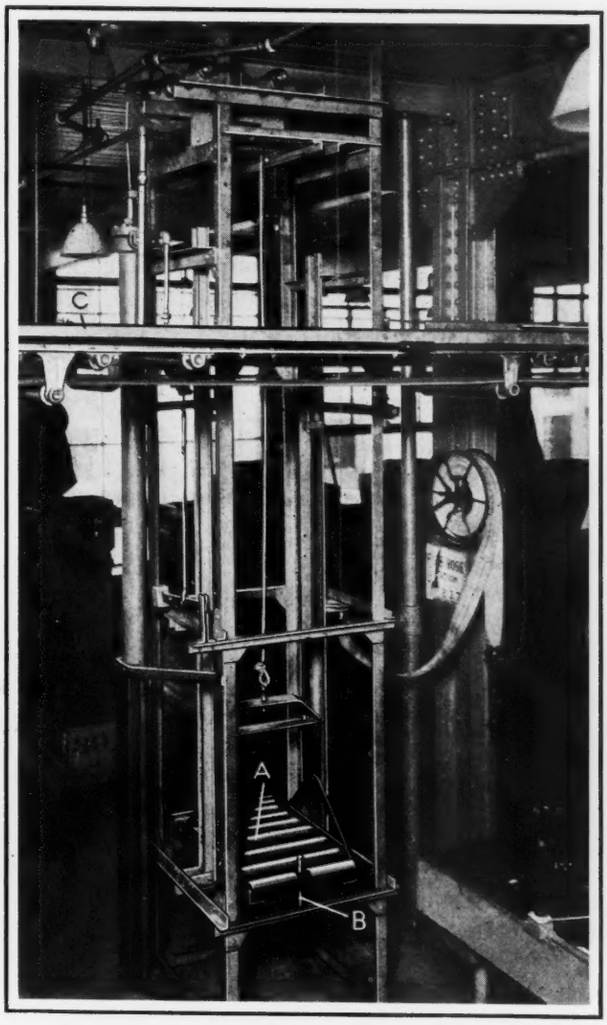


Fig. 8. Air-operated Hoist Used to Lift Work Boxes on a Horizontal Belt Conveyor

In some of the departments, the conveyor system described serves a large number of standard and special machine tools, there being more than 1900 machines in building No. 14 alone. Work produced by over 600 automatic screw machines is delivered to other departments of the plant for washing, inspecting, heat-treating, and assembling. The work, together with the chips, is carried to a large separator from which the chips are passed into oil reclaiming equipment while the work goes in boxes to washing machines in the basement of a separate building. Small work produced in punch presses, milling machines, drilling machines, etc., is also routed to the washing machines. Many parts are carried to the plating department on the fifth floor of building No. 3, and many parts to the heat-treating division in building No. 15. Finished parts are inspected on various floors and finally delivered to the assembly departments, of which there are seven or eight in the buildings served by this conveyor system.

* * *

THE AERONAUTICAL INDUSTRY IN 1929

According to preliminary statistical information supplied by the Department of Commerce, approximately 6000 commercial and 1100 military airplanes were built in 1929, and 6350 airplanes were actually sold. There were about 6000 airplane engines produced during the year, of which 5800 were sold. The factory capacity for building airplanes in 1929 was approximately 10,000, and the factory capacity for building engines, 8000.

Current Editorial Comment

In the Machine-building and Kindred Industries

PREPARE FOR THE NEXT INCREASE IN BUSINESS

The peak in production in most of the machine-building industries was reached last May and June. Since that time there has been—in accordance with the usual business cycle—a slackening in demand. This has given shop executives a chance to catch their breath, so to speak, and to turn their attention to the methods and equipment in use in their plants. During the peak period there was no time to think of anything but production; now there is an opportunity to make a study of production methods. It will pay to inspect all machines in order to determine which are good enough to keep; those that are still of value should then be put in good condition before the pressure of production again demands their continuous use.

Such an inspection will also demonstrate that many machines are obsolete and that it is not economical to repair them or to continue to use them. Now is the time to replace machines of this class with the right kind of modern equipment. The more promptly new equipment is installed, the more certain it is that full benefit will be derived from it as the new peak in business approaches.

Several plants are engaged in making such a survey of their equipment at the present time. They are listing the machines that should be replaced. In one plant it was found advisable to place orders for $150,000 worth of machine tools. The orders were placed for delivery in from three to six months, with a view to having a well equipped shop ready for efficient manufacturing when the next rush in business comes along. The far-seeing executive will not neglect this opportunity to put his plant on a profit-paying basis.

* * *

GROWTH OF THE AIRPLANE INDUSTRY

During the period of development of any new mechanical industry the machine or device produced is almost always costly, because the limited output does not warrant extensive application of interchangeable manufacturing methods. This has been especially true of the airplane industry. In the last few years, however, the use of airplanes has increased to such an extent that the production of planes reached a total of nearly 4400 in 1928, and 7100 in 1929; and engine production has, of course, increased in the same proportion.

To meet the demand for so large a number of airplanes, many plants have adopted highly efficient methods for manufacturing both planes and engines. The latter are now built in shops employing the same practice as that used in other quantity production plants. The methods are quite similar to those used in automobile factories.

A leading concern recently placed in operation a plant having a floor space of 420,000 square feet—approximately 10 acres—exclusively for the manufacture of airplane engines. In this shop are installed over 700 modern machine tools equipped with special tooling and individual motor drives. In other plants, jigs and fixtures are used to insure uniformity in the welding of the framework of planes. Briefly, the airplane industry has grown up and is now in a position to employ modern machinery and methods with a view to economical production.

* * *

THE NEW CAST IRON

Cast iron is such an old material and has been applied so widely, and for such a great variety of purposes, that the idea of a new cast iron may seem strange. Everyone knows about the great developments that have taken place in steels and in the numerous non-ferrous alloys, but the recent important changes in cast iron have not received the publicity merited by their economic value to manufacturers of mechanical apparatus.

The term "cast iron" has been generally understood to mean a material having a tensile strength of 15,000 to 20,000 pounds per square inch; but this idea is no longer correct, for there are perhaps as many kinds of cast irons as of steels, and these irons cover a wide range of physical properties. Many foundries now are producing reliable gray iron castings having tensile strengths ranging from 30,000 to 60,000 pounds per square inch, and with very much higher increases proportionately in the impact strength. These important changes in the physical properties are the result of excellent co-operation between the metallurgist and the foundryman, and they have been obtained by the proper use, either singly or in varying combinations, of such metals as chromium, nickel, molybdenum, and vanadium. The success achieved in producing these modern castings is the result of working primarily to obtain quality, so that the increase in reliability and strength much more than offsets the increase in cost. This notable development is of importance to practically all manufacturers of mechanical apparatus.

It should not be assumed that every gray iron foundry is able to produce these newer high-strength cast irons, because in most instances, special methods and equipment are needed; but there are many foundries that have been successful in producing these new cast irons to meet the present-day needs of industry.

The Foreman's Job in Breaking in New Men

Training the Worker for the Job is One of the Most Important of the Many Responsibilities of a Successful Foreman

IN a recent foremen's conference, the question of how best to fit workers to the job came up. It was pointed out that a large part of the responsibility of a foreman relates directly to the workers. The relations between the foreman and the workers are, in the last analysis, the relations between the firm itself and its employes. The handling of the men is the most important phase of a foreman's job, but unfortunately, it is one for which the average man, when he is promoted to the position of foreman, is least prepared. Among the most difficult duties of a foreman is that of training a man for his job.

The necessity of matching the man and the job properly—getting the right man in the right place—is one of the essentials of good management. When a given group of jobs is to be filled by a given number of men, the greatest care must be exercised in fitting each man as nearly as possible to the job. This statement seems self-evident, and yet experience shows that this problem seldom receives adequate consideration. Employes are too often selected for a job without proper consideration being given to their temperament, ambition, alertness, dexterity, and other personal characteristics.

When a Man Does not Fit the Job, the Management Loses as Well as the Man

When men hold jobs for which they are not fitted, the result is a tremendous waste—waste to the management and waste to the men. The methods used to avoid misfits vary widely with the conditions. There are, of course, innumerable differences in people and an almost equal variation in the character of jobs. Unless these differences are taken into consideration in placing men on their jobs, neither the company nor the workmen can secure the proper returns from their efforts.

In considering individual differences, attention must be given in the case of many jobs in machine shops and industrial plants to the height, weight, and strength of the applicant, and, in addition, to his skill, general intelligence, temperament, quick perception and similar characteristics. The judgment of whoever hires the man or transfers him from one job to another must be depended upon to a large extent.

When Possible, Make Use of Men Already Employed by the Firm

When there is a vacancy, where should the foreman turn first to fill it? He should, if possible, fill the job in his department by promoting a man from a less desirable job. This has a twofold advantage; first, a man from his own department knows of the location of tool-cribs, oil supply, general shop methods, etc.; and second, he knows the foreman, as well as the general characteristics of the other men with whom he works. These things an outsider must learn. When it is understood that first consideration is given to men already employed by the firm, the morale of the organization will be raised.

How to Get the Right Man from the Employment Department

When the right man is not available in the foreman's own department, his requisition to the employment department should give as nearly as possible the exact qualifications required, keeping in mind that the available men in most instances are of average ability and intelligence, and that he should not ask for men with unusual qualities, unless the job is of an exceptional type. Even an exceptional man must be taught many things when entering a new department, regardless of his skill.

The Treatment Accorded the New Employe is of Great Importance

The reception accorded a new man has an important bearing on how quickly he will adapt himself to the job. A new employe almost invariably is ill at ease. This, in a measure, is just as true of skilled and experienced workers as of unskilled. The first task of the foreman is to make the new man feel at home. This may be done in many ways. Back of every successful way is the display of a genuine interest in the man.

The foreman gains his confidence by spending sufficient time with him to acquaint him with the company's policy, the type of product manufactured, the special features of the machinery used, and where he will find everything that he may need in doing his work. Most foremen have difficulty in obtaining the viewpoint of the new man; but the more nearly a foreman can put himself in the place of the newcomer, the greater will be his success in dealing with him.

The mind of a new employe is filled with questions, doubts, and fears. He is constantly thinking "Will I make good?" He is concerned as to whether he will be able to get along with the foreman and the other men in the department. He is interested in the regularity of employment, and he wants to be sure that he will be able to earn as much as he is accustomed to earn. To dispel his doubts and fears is one of the problems of the foreman. The more successful a foreman is in this respect, the more efficient will his department be.

Many foremen consider the breaking in of a new man the most difficult part of their job. Some prefer to shift this responsibility to someone under

them, saying that they "do not have the time" to break in new men themselves and that "other things are more important." This is almost always a mistaken view. The foreman must find time to do that part of the job that is really one of the most important things he has to do. It can easily be demonstrated that to teach a new man how to do his work requires less time than to correct the mistakes that he will make, if he is expected to get along as best he can or to obtain his information from other workmen.

If a Man Does Not Make Good on the Job, Whose Fault is It?

When a new man does not make good on the job, whose fault is it? Of course, the fault may be with the man himself; he may have misrepresented his ability to fill the job. But in many instances, the fault is with the foreman who breaks in the man. When a foreman feels that he must discharge a new man because he is not giving satisfactory service, he should always ask himself the question whether he has given the man a real opportunity to make good. Has he given him all the instruction and training that he is entitled to in order that he may definitely show whether he can make good or not?

* * *

The pursuit airplane designated P-6 Hawk, recently developed for army use by the Curtiss Aeroplane & Motor Co., is powered by a Curtiss Conqueror D-12 600-horsepower engine. This engine utilizes the new Prestone cooling system developed by the engineering section of the United States Army Air Corps. The plane has a maximum speed of 181 miles per hour, and is of the single-place biplane type. The cruising speed is 145 miles per hour and the stalling speed 61.3 miles per hour. The rate of climb is 2170 feet per minute and the maximum height reached, or "ceiling," 24,400 feet. The framework is of chrome-molybdenum steel. The weight of the plane when empty is 2430 pounds, and when loaded, 3154 pounds.

THE COMING LEIPZIG FAIR

The Leipzig Spring Fair and Machinery Exposition this year will be held March 2 to 12. Without interruption, the Leipzig Fair has been held twice a year for nearly 700 years. It is expected that the number of exhibits and visitors this year will at least equal and possibly surpass those of last year, when there were 2364 exhibits in the engineering material and equipment division. The total number of exhibits of all kinds was over 10,000.

In the engineering exhibits, 720 pertained to industrial machinery and machine tools; 524, to electrical equipment; 171, to power and transmission machinery; and 277, to iron and steel products. There were 36 exhibits from the United States. The total number of foreign exhibits was 1273; the remainder were of German origin. This year it is stated that there will be more than 100 American exhibits at the fair. Visitors to the fair are registered; last year the total attendance was over 165,000, of which 136,600 were Germans and 28,700 visitors from foreign countries, those from the United States and Canada numbering over 2000. Of the registered visitors, over 50,000 attended the machinery, electrical, and engineering equipment exhibits.

Some of the Sixteen Machinery and Engineering Equipment Exhibition Buildings at Leipzig

The engineering exhibits are housed in sixteen large exhibition halls. One of these, erected in 1928, is shown in the center of the accompanying illustration. This building is 500 feet long, 370 feet wide, and 70 feet high, and is spanned with a roof without internal supports or pillars. Those interested may obtain additional information about the exposition by addressing the Leipzig Trade Fair, Inc., 11 W. 42nd St., New York City.

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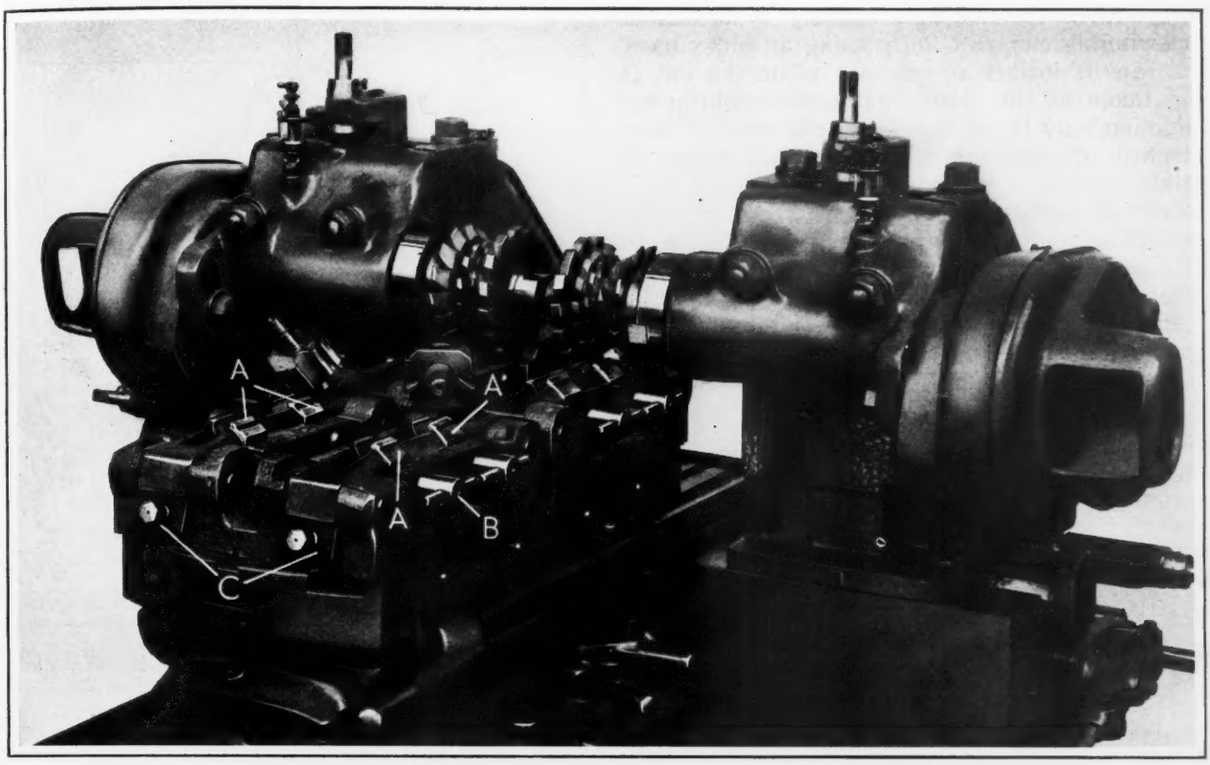
In one of the publications of the Department of Commerce, it is mentioned that an American manufacturer exhibiting machinery at the Barcelona Exposition more than defrayed the costs of his exhibit by manufacturing a product directly in the exhibition building and selling it to local dealers.



Milling in Electrical Refrigerator Plants

How the Time Between Cuts is Reduced to a Minimum by the Use of Automatic Milling Machines Equipped with Suitable Fixtures

THE rapid growth in the sales of electrical refrigerators has made it possible to introduce high-production methods in their manufacture. For milling operations, for example, it is now possible to use machines of the automatic type, having table movements controlled automatically by dogs. Several examples are given in this article to show the adaptability of this type of machine to a variety of jobs, the work being performed on machines built by the Cincinnati Milling Machine Co.

Use of Index Base for Milling Cast-iron Cylinders

Fig. 5 shows a cast-iron cylinder used in a refrigerator. The surfaces indicated by the heavy lines are milled on an 18-inch duplex automatic milling machine, the set-up being shown in the heading illustration. With this equipment, production was more than doubled, as compared with the method previously used. Through the use of the duplex arrangement, it is possible to adjust each gang of cutters independently to suit the cut. The 12- by 24-inch standard index base is equipped with two progressive type fixtures, each holding two rows of two pieces each, as indicated at *A*.

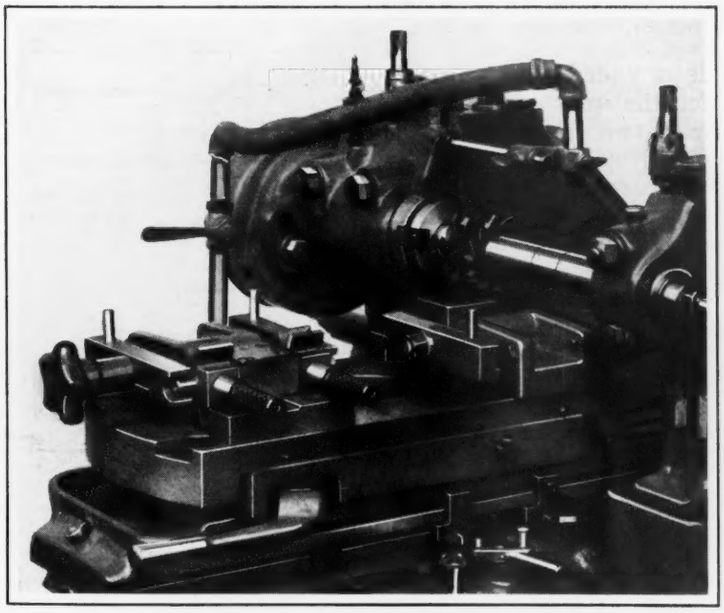


Fig. 1. Set-up for Beveling Corners of Cylinder Fins Shown in Fig. 6

The cylinders are located by placing their trunnions in slots in the fixture. Plugs *B* are then inserted through the cross-holes in the cylinders to locate and support the work during the milling operation.

The cylinders are fastened securely by means of four swinging clamps *C*. By using an index base, work can be loaded at one end while the cut is being taken at the other, and almost continuous production may be obtained. The automatic dog-controlled intermittent table movement makes it possible to traverse rapidly up to the cut, mill, traverse rapidly across the air gap between the parts to be milled, mill again, and finally return to the loading position.

The cutters revolve at 80 revolutions per minute, and the table feed is 7 3/4 inches per minute. The output is 126 pieces per hour.

Magnetic Type of Milling Fixture

In Fig. 2, an 18-inch manufacturing milling machine is used for milling clearance slots in both sides of the forged steel bearing plates shown in

Fig. 2. Magnetic Fixture Used for Holding Bearing Plates

Fig. 3. This machine is provided with a special indexing fixture on which the work is located by two pins projecting through two previously drilled holes in the bearing plate. No mechanical clamps are used, as magnetic means are provided for holding the work securely during the milling operation. An automatic switch operated by a lug on the table releases the work at the completion of the operation.

The fixture is designed for indexing to two positions 7 degrees apart. The operations for one complete cycle are as follows: (1) The casting to be milled is placed over the studs, as mentioned, and magnetically clamped. (2) The knee is raised into position, bringing the work up to the cutters until the desired depth of cut is obtained; the starting position is the end of the slot farthest from the center of the piece. (3) The feed is thrown in and the slot milled toward the center. (4) When the cutter has reached the center of the opening, the fixture is indexed 7 degrees. (5) The slot on the

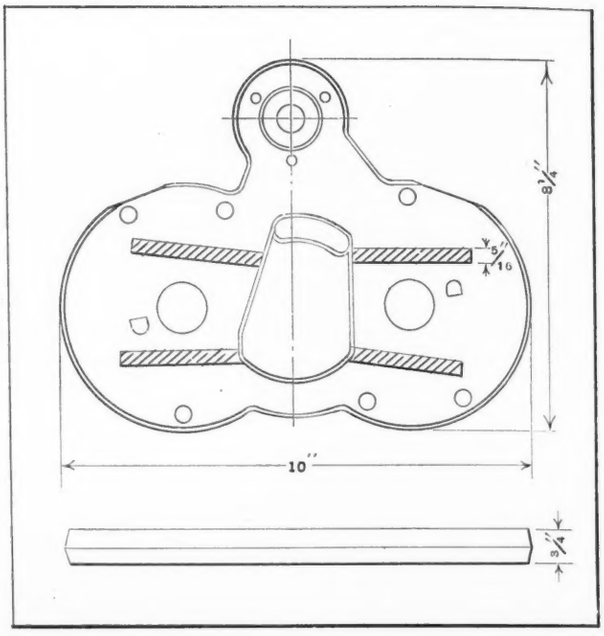


Fig. 3. Bearing Plate in which Slots are Milled while Held in Magnetic Fixture Shown in Fig. 2

other side of the center is milled. (6) The knee is lowered, which automatically releases the magnetic chuck; the casting is then taken out of the fixture and turned over. (7) The knee is again raised, bringing the work toward the cutters until the proper depth of cut is reached, and the operations mentioned under (3), (4), (5), and (6) are repeated, after which the finished casting is removed from the machine.

The stock removed is 0.012 inch, the cutters revolving at 117 revolutions per minute. The production is 25 pieces per hour.

The vertical adjustment of the knee is obtained by hand, but for the throwing in and out of the horizontal feed the machine is equipped with an extra feed throw-in dog and two stop-dogs with a stop-block.

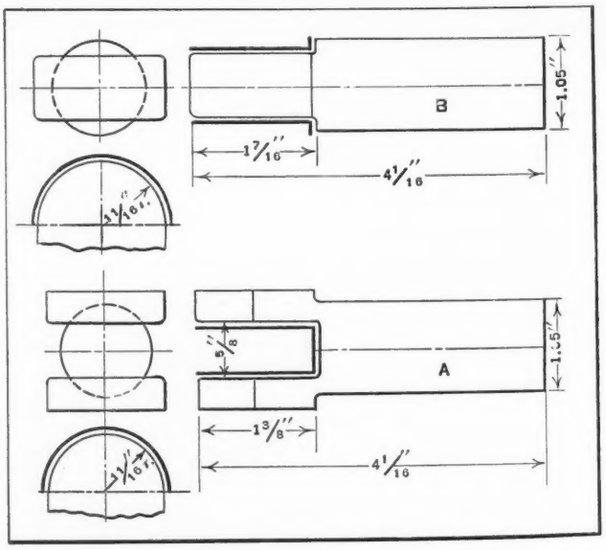


Fig. 4. Two Pistons Milled Simultaneously with Set-up Shown in Fig. 8

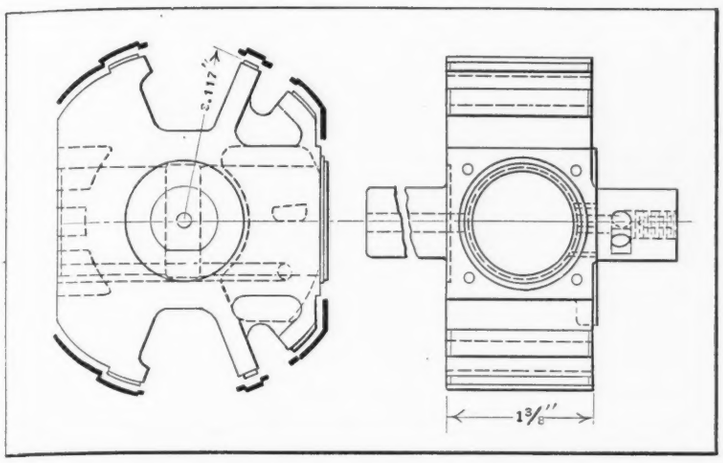


Fig. 5. Cylinder Milled with Set-up Shown in the Heading Illustration

Performing Three Milling Operations on the Same Machine Simultaneously

The milling of the slot, the straddle-milling of the sides, and the form-milling of the end of the two pistons shown in Fig. 4 are accomplished simultaneously on a Hydromatic milling machine on which all the table movements are automaticallly controlled by dogs. A 16- by 30-inch standard index base, as shown in Fig. 8, is clamped to the table of the machine, and two progressive type fixtures, each holding four pieces of work arranged in pairs, are mounted on the ends of the index base. The round shanks of the pieces to be milled are held in the fixture by half-round straps, while screw supports bearing against the heads of the pieces take the thrust of the cutters. Stops are provided on the fixtures to adjust the height of the work in order to compensate for possible cutter wear.

The cylindrical part of the piston was made hollow, in order to reduce the weight to a minimum. This added to the difficulty of designing the fixture, since it necessitated making it so that the total thrust of the cutters would be taken by the head of the piston.

Of the two pistons in one-half of the fixture, one is being slotted while the other is straddle-milled by the cutters near the inner arbor support. In the other half of the fixture, nearest the spindle carrier, two pistons are being form-milled. The cut is taken through solid stock on the head of the piston. The production is 23 pieces per hour.

An Example of the Use of an Automatic Indexing Base

An interesting operation consisting of milling the lugs on a main frame is shown in Fig. 7. The work is performed on an 18-inch plain automatic milling machine equipped with a special vertical spindle carrier. Three lugs or feet on the outside of the casting shown in Fig. 9 are milled. A single fixture holding one casting is mounted on a three-position automatic indexing base, as illustrated in Fig. 7. The work is located by means of the circular bottom and three small lugs on the base. A sliding clamp and screw on each side of the casting hold it in the correct position for milling.

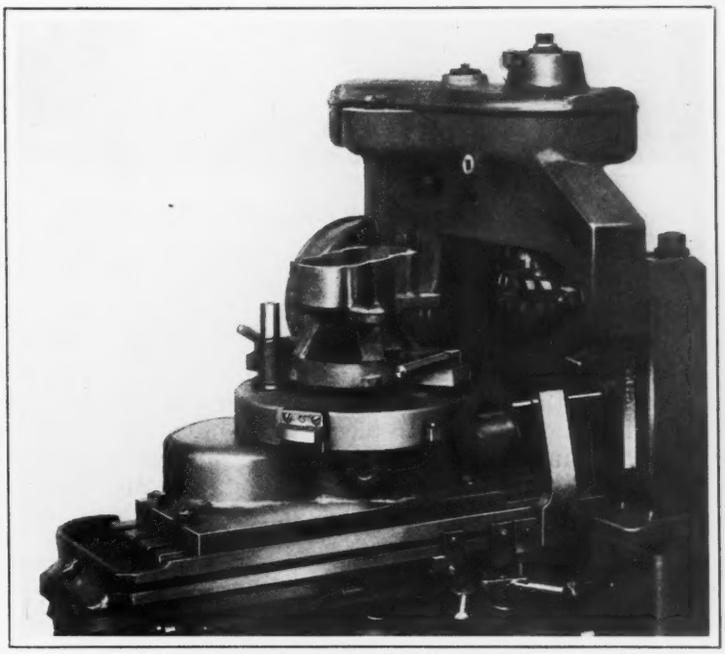


Fig. 7. Milling the Lugs of Main Frame Shown in Fig. 9 by the Use of an Automatic Indexing Base

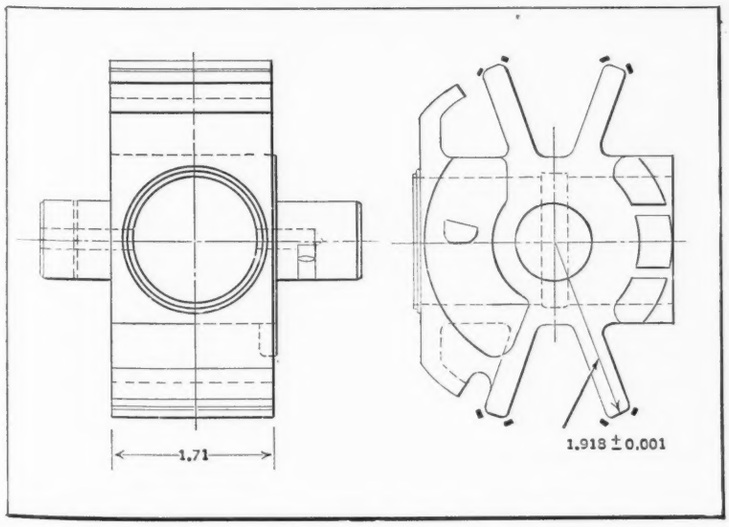


Fig. 6. Cylinder Fin Corners Beveled with Set-up Shown in Fig. 1

The operator clamps the work and starts the machine, but all other operations are automatic, including the rapid return of the table to the starting position after the three lugs have been straddle-milled. The cutters, revolving at 60 revolutions per minute, remove 3/32 inch of stock with a

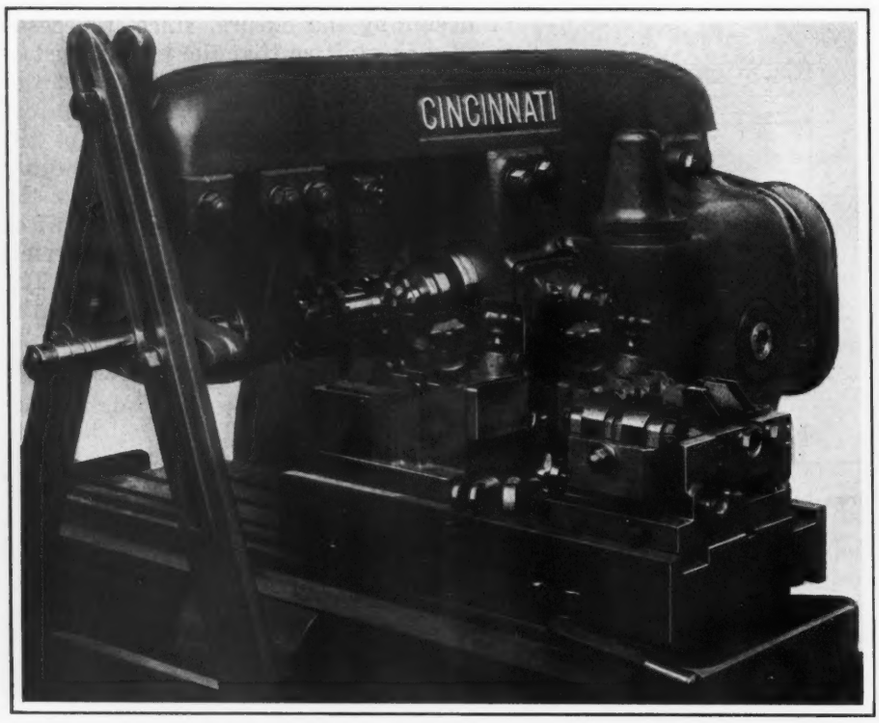


Fig. 8. Set-up for Straddle- and Form-milling Two Pistons Simultaneously

feed of 10.2 inches per minute. The output averages 60 pieces per hour.

Saving Time by Rapid Traverse Between Cuts

The index base method of milling is also used in bevel-milling the corners of the fins of the cylinder shown in Fig. 6. An 18-inch plain automatic milling machine is used for this job. Two fixtures are used, one mounted on each end of a 12- by 24-inch standard index base, as shown in Fig. 1. Each fixture holds two cylinders in tandem. The cylinders are located by placing one of the trunnions extending from the side of the piece in a slot in the fixture. A plug is then inserted through a cross-hole in the work to locate and support the piece while it is being milled. An important feature of the operation is that the table moves from one piece to the next at a rapid traverse rate, automatically controlled by dogs.

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SAVINGS THROUGH SIMPLIFICATION

A few examples of the simplification in manufacturing that has been accomplished through the cooperation of industry and the Department of Commerce are mentioned in a recent number of *Commercial Standards Monthly*. The number of files and rasps regularly listed by manufacturers has been reduced from 1351 to 475; the number of sizes of steel lockers has decreased from 65 to 17; and the types of metal lath, from 125 to 24. It is estimated that in ten different industries that have applied the simplified practice recommendations on a very large scale, annual savings of $300,000,000 are being made. Altogether the Department of Commerce has cooperated with industry in making 105 simplified practice recommendations.

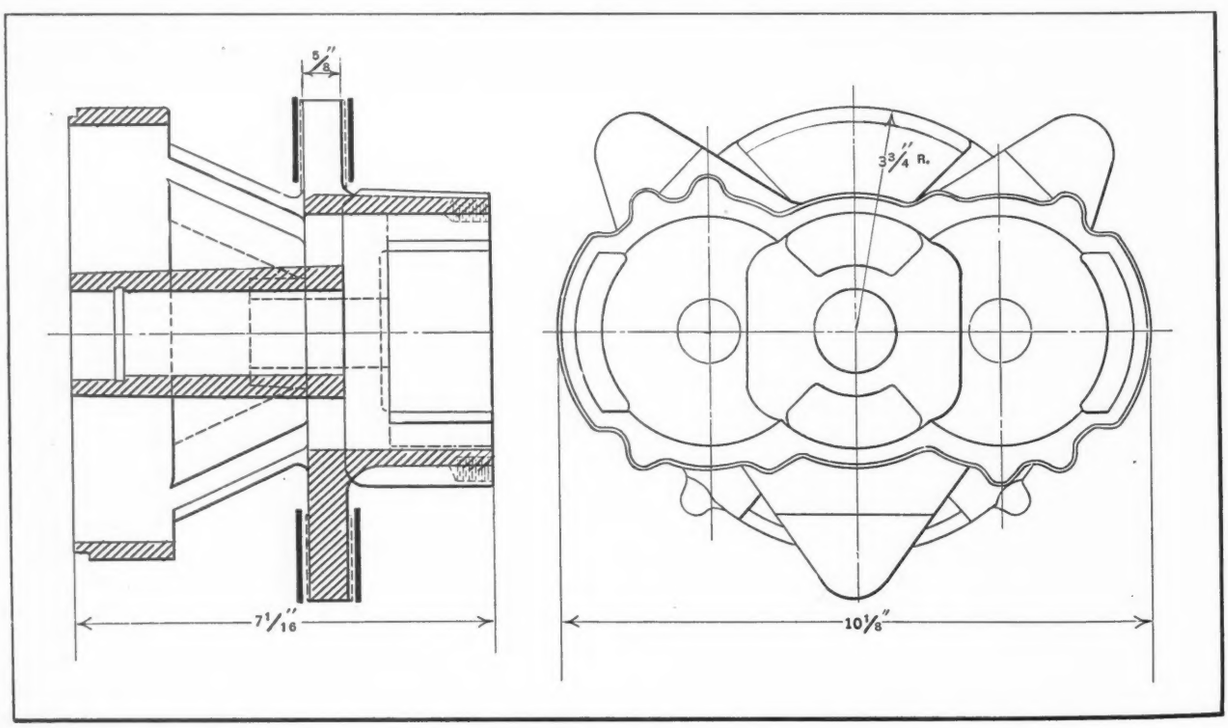


Fig. 9. The Three Lugs on This Main Frame are Straddle-milled with Set-up Shown in Fig. 7

LUBRICANTS FOR LOW-SPEED BEARINGS

For bearings that carry considerable load but operate at low speeds, the oils used for general lubrication are not suitable, and consequently lubricants of an entirely different nature are employed, either solid or semi-solid. At low speeds the ordinary film of oil is so thin that it is swept aside.

Graphite and Graphitic Lubricants

Of the solids used as lubricants, the best known is graphite, but soapstone is also used to a limited extent. Good graphite has a lamellar structure, and will withstand considerable pressure if applied perpendicularly to the face of the laminae. Slight side pressure is sufficient, however, to cause cleavage. The action of graphite in a bearing is largely mechanical. Under the side stresses, the flakes break up and fill all the irregularities in the surfaces of the bearing, making a skin that is extremely hard and smooth, with a very low coefficient of friction.

For cast iron, especially, graphite is excellent, but it gives almost as good results with other bearings. Good quality graphite has an unctuous feeling when rubbed between the fingers, and is not gritty or harsh. Some samples may contain a proportion of mica, but if this is free from quartz or other hard minerals, it is not particularly harmful.

Both graphite and soapstone are used in conjunction with animal fats, greases, petroleum jelly, and resin greases to make stiff pastes for heavy and rough work. In combination with a good grease, graphite is extremely useful, as it remains in position on the bearing even if the metal gets hot enough so that all the soap and oil in the grease run out.

Resin grease forms another vehicle for graphite. This is made by mixing slaked lime with resin oil, which must be unrefined. Refined resin oil will not form a grease, owing to the absence of free resin acids, and the higher the percentage of free acids, the stiffer the grease. Usually resin grease is thinned out with oil, but this is not necessary when graphite is to be incorporated and the mixture used for low speeds only. It cannot be used in brass bearings because of the chemical change that takes place, causing it to attack the brass.

Most graphite pastes are made by working together graphite and a mineral oil thickened by a metallic soap, usually lime soap. The stiffness varies with the proportion of lime soap present, which is generally in the neighborhood of 15 per cent. Occasionally petroleum jelly is used as a vehicle for graphite, in which case the graphite should not be less than 12 per cent.

Substitutes for tallow and other natural fats are sometimes offered as a vehicle, and it is claimed that these substitutes will not turn rancid as the natural fats do. One such substitute was examined and found to consist approximately of 60 per cent of powdered gypsum, 5 per cent of a fatty oil, 20 per cent of petroleum jelly, and 15 per cent of water. The substance would not turn rancid, but is of less value as a lubricant than even a very rancid tallow.

Metallic Soaps as Lubricants

Metallic soaps are quite good lubricants in themselves. They are made by saponifying a metallic oxide with caustic soda or by the inter-action of a solution of a salt and an ordinary soda soap. Hurst gives the following directions for the making of aluminum soap, which is used alone, as well as with oil, which it thickens. One hundred pounds of commercial oleic acid is mixed with 20 gallons of hot water and a solution of 16 1/4 pounds of caustic soda, containing less than 77 per cent sodium oxide, in 10 gallons of water, and boiled until saponification is complete. A solution of 70 pounds of alum in 20 gallons of water is then added to the soap solution, when the aluminum soap separates in greasy masses. Moisture is removed by pressure. It is necessary to be certain that there is no free oleic acid in the finished soap.

Greases as Lubricants

Axle greases are made by thickening oil with lime soap, though in some cases petroleum residuum and recovered fats are used. It is essential that the grease be homogeneous, and that, when it melts, the whole shall liquefy, and not the oleaginous part only. Nor should there be any more than a very small quantity of mineral matter present other than the lime combined as soap.

A good wagon axle grease, eminently suitable for heavy bearings for low speeds, contains about 68 per cent of light lubricating oil, 21 per cent of lime soap, and 6 per cent of water. This grease melts at 190 degrees F., and is all liquid at 225 degrees F. It is not too stiff for use at ordinary temperatures.

Fixed oil, mineral oils, and blends of both are also used for low-speed bearings. It is interesting to note that in France the engineers of the Paris, Lyons, and Marseilles Raillway found that the best lubricant for the journals of a heavy swing bridge working under very heavy loads was paraffin oil, as it maintained the necessary film between the surfaces when heavier oils and jelly and greases had been quite useless. It also gave a low coefficient of friction. Paraffin is not considered a lubricant, as a rule, especially in such a case as that mentioned.

From time to time preparations are suggested as coolers for overheated bearings. If a bearing becomes hot, it is an indication of imperfect lubrication either in quality or quantity or of grit or abrasive material in the bearing. The use of a grease instead of an oil may make an appreciable difference in the temperature of a bearing, and if any grit finds its way in, the temperature rises rapidly. The real remedies for overheated bearings are to use the proper lubricant in sufficient amount, and to make sure that they are free from abrasive matter.

Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices

MACHINING DOUBLE-RADIUS CHAFING BLOCKS FOR LOCOMOTIVES

By J. H. HAHN

The fixture shown in Figs. 1 and 2 is used for machining the double-radius surfaces of floating chafing blocks used on locomotives and tenders. These chafing blocks, one of which is shown at *W*, Fig. 1, are generally made of cast steel. The castings are delivered to the machine shop with about 1/2 inch of surplus stock on the contact faces.

A large boring mill equipped with a fixture capable of holding several castings can be used to advantage when the chafing blocks are machined in large lots. In shops where only a small number of castings are to be machined, time can be saved by handling the work on a planer equipped with a fixture like the one shown in the illustrations. The fixture can be set up quickly, and it can be left on the end of the planer table, where it will not interfere with other work ordinarily handled on the machine.

The casting shown at *W*, Fig. 1, is machined to a radius of 16 inches, as viewed from the end as well as the side. In other words, the work has the same form as a rectangular section cut from a ball having a diameter of 32 inches. The flat base of the casting is machined first. The casting is then mounted in the fixture as shown, with the machined face resting on the finished surface of the fixture. The work-holding member *G* of the fixture is pivoted on trunnions *F*.

In order to take a radius cut lengthwise, member *G* must be pivoted or rocked on the trunnions at the same time that the planer table carries the fixture forward. The required rocking motion is obtained by means of an arm *E* bolted to the member *G* and a member *D* bolted to the inside of the planer housing. A roller at the end of arm *E*, moving in the slot in member *D*, imparts the required rocking motion to the work-holding member of the fixture. This arrangement is the same as that used in various shops for planing links and other parts to conform to a given radius.

An offset is provided in the slot in member *D* to correct any errors introduced by changing the angular position of the bar to accommodate parts of small radii. The amount of this offset can be determined by checking the movements of the fixture and the position of the roller at the end of arm *E* while the machine is in motion. The amount of the error is so slight that it need not be taken into consideration when parts are being machined to a radius greater than 20 inches.

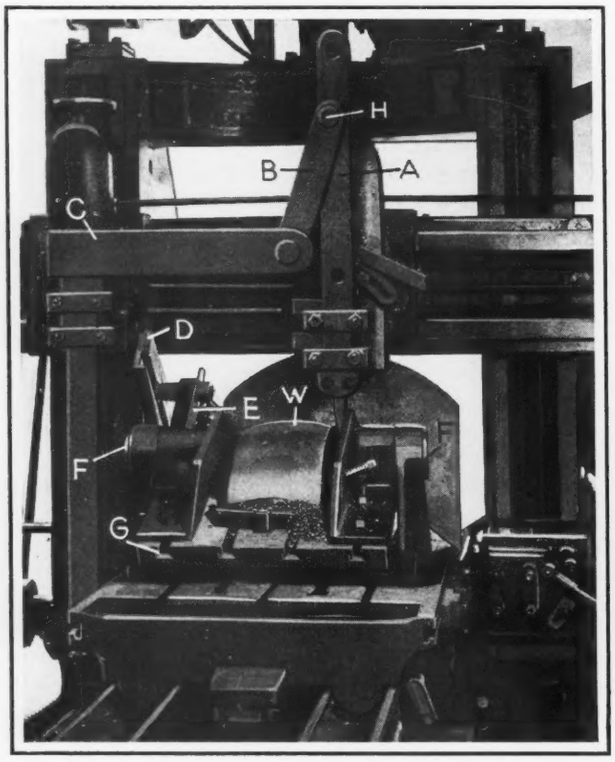


Fig. 1. Planer Equipped with Link Arrangement for Radius-forming

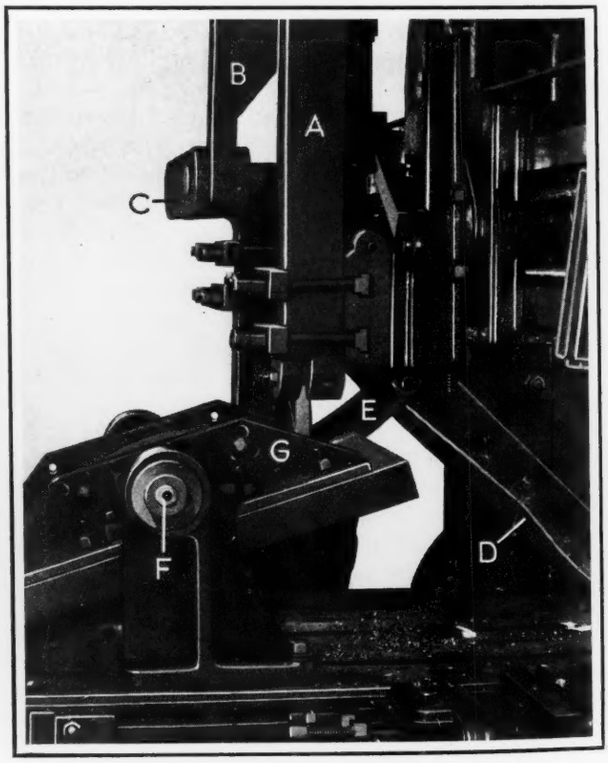


Fig. 2. Side View of Radius-forming Fixture Shown in Fig. 1

In order to machine the work to a radius, as viewed from the end, at the same time that it is being machined to a radius lengthwise, it is necessary to make use of the members *A*, *B*, and *C*. The bar *C* is clamped in the left-hand head of the planer as shown. An extension tool-holder *A* is clamped in the right-hand head. To the upper end of this tool-holder is fastened a link *B*, which connects bar *C* with holder *A*. The distance from the center of the stud *H* at the upper end of link *B* and the center of the stud connecting link *B* with bar *C* must be equal to the radius of the part to be machined.

The vertical feed-screw in the right-hand planer head is removed to permit the head to travel along a radial path when the horizontal feed is used so as to swivel link *B* about the stud *H* at its upper end. By inverting link *B*, a concave surface can be machined. This is done by attaching stud *H* to bar *A* at a point below bar *C*. For different crosswise radii, it is only necessary to use links *B* of the required lengths. A change in the radius machined lengthwise of the work is obtained by setting slide *D* to a different angle. To machine a concave surface lengthwise of the work, necessitates changing the position of slide *D* so that its rear end is above the roller at the end of arm *E* and the opposite end is below this point. Templets made from 1/8-inch plate steel are used to test the accuracy of the radius-formed profiles on the work.

* * *

WELDING JIGS FOR DUPLICATE WORK

Use of the proper jig in welding has a very important bearing upon the production rate in any factory. Automobile manufacturers have long realized this, and no little credit for the amazing yearly totals of the leading motor car producers is directly due to the universal use of all sorts of jigs throughout the entire production line. Sheet-metal shops employing welding for the fabrication of their products are also large users of carefully designed jigs. Many sheet-metal plants have increased their rate of production several hundred per cent in this way.

The adoption of a simple jig by a concern engaged in turning out flask bands for foundry use did away with the necessity of installing expensive special equipment. The accompanying illustration shows a welder using this jig while joining the flask band. These bands, which are nothing more than a strip of sheet steel bent in the form of a rectangle, are used in the foundry to bind together the wooden flask or box that holds the sand mold for a casting. To complete the rectangle, it is necessary only to close one corner by welding.

Referring to the illustration, it will be seen that the band is held between two pieces of metal. These are simply short pieces of angle-iron nested one into the other, turned upside down and clamped to the table. The heel of the upper angle has been coped out so that an oval hole is left. A simple treadle arrangement consisting of a piece of steel wire and a bar completes the fixture. The corner of the band to be welded is slipped between the two

Jig Used in Welding a Flask Band

angles until it is opposite the hole. Then pressure on the treadle clamps it in place during welding.

The effectiveness of this jig should encourage welders to think out similar ones for their own work. Very often such a handy welding aid will materially speed up production and greatly facilitate the job at hand.

* * *

WESTINGHOUSE BUILDS NEW ENGINEERING LABORATORY

An expenditure of $1,500,000 will be made by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., in the construction of a central engineering laboratory and an addition to the present direct-current power laboratory. The buildings will make it possible to experiment with and test power and engineering units of large size. Generators big enough to supply electricity to a town of 10,000 people, for example, will be used merely for experimental work. A laboratory in which artificial weather—hot or cold—can be produced will be provided for in the "weathering rooms," where sunshine or rain, winter cold or summer heat will be created for testing apparatus built for outdoor service. Any given condition of temperature, atmospheric pressure, or humidity may be produced.

The new laboratory will eventually replace numerous smaller laboratories and experimental testing rooms now scattered throughout the Westinghouse plant. The laboratory will be an 11-story structure, 225 feet long by 80 feet wide. The extension to the direct-current laboratory will be 125 feet long.

Equipment for Annealing Wire Wheel Hubs

Annealing Installation which is Automatically Operated, Even the Doors of the Furnace Being Opened and Closed by Time-clock Control

By W. M. HEPBURN, Vice-president, Surface Combustion Co.

THE redesigning of a part so as to make possible the application of new methods and a reduction in the number of manufacturing operations, with the accompanying saving in costs, is well exemplified in the case of the hub shell for a wire wheel, shown in Figs. 1 and 2. Fig. 1 shows the number of steps required in the manufacture of an old type hub shell and ring, while Fig. 2 shows the number of steps in the redesigned type. The work, as shown in Fig. 2, is carried out at the plant of the Wire Wheel Corporation of America in Buffalo, N. Y.

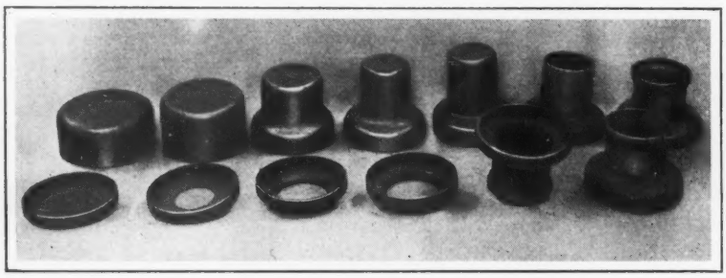


Fig. 1. Thirteen Steps in the Manufacture of the Old Type of Hub Shell and Ring

The shell formerly used required eighteen different operations and processes, including four annealings. The present shell requires only twelve operations, including three annealings. Similarly, the operations on the ring have been reduced from eleven to four. As may be seen from the illustrations, the hub is made in two pieces, a shell and a ring. In the old method of manufacture, the ring was pressed into the shell, but in the new method the two are welded together. Both pieces are pressed out from 3/16-inch steel plate.

The press operations include some very severe draws, and the annealing between these must be very carefully carried out. The furnace that is used is completely automatic and continuous, both as regards operation and temperature control. It was designed and built by the Surface Combustion Co. of Toledo, Ohio. The length of the furnace is 43 feet 6 inches; the width, 8 feet 6 inches; and the height, 3 feet. The work is pushed through the furnace by a motor-operated mechanical pusher. The motor and pusher are operated intermittently by means of a time clock control, which regulates the period during which the work remains in the furnace.

The furnace is of the counter-flow type, being divided into two sections longitudinally, so that a separate line of work passes continually through each section in parallel, but in opposite directions. The hot zone is in the center, and the heat passes toward both ends. The zones at the ends are known as heat interchangers, because at these points considerable heat is given off by the hot outgoing work and is absorbed by the cold work entering. This feature increases the efficiency of the furnace.

The center or hot zone is 20 feet long and the heat interchange zones are each 11 feet 6 inches long. Six metal rails are laid on the hearth. These are of alloy steel in the hot zone and of cast iron in the other two sections. They project 4 feet beyond each end of the furnace. These extensions form loading and unloading platforms (see Fig. 3). The hearth is supported by piers.

Principle of Operation of the Furnace

The operation of the furnace is as follows: Trays loaded with the work are placed on each platform in front of the pushers. At the proper time interval, a clock operates a relay, which, in turn, starts lifting the motor-operated doors. When the doors have reached the open position, they make contacts which start the pushers on the forward stroke. The pushers, in turn, upon the completion of their stroke make contact with a limit switch which reverses the stroke action and causes the pushing rods to return to the starting position. At this point, the contacts are broken and the motor-operated doors automatically closed.

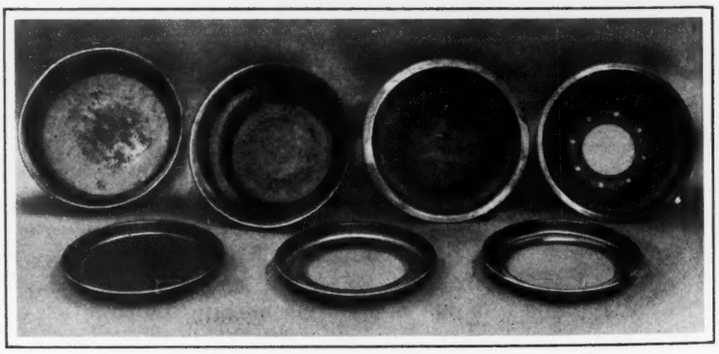


Fig. 2. Seven Steps in the Manufacture of the New Type of Hub Shell and Ring

The loaded tray under the door at the discharge end is removed by hand before the door closes. It is then unloaded, moved over in front of the pusher on the adjoining charge platform, loaded, and automatically pushed into the furnace at the proper time interval, as determined by the time clock.

Methods of Heating the Furnace

Heat is supplied to the hot zone of the furnace through thirty-two gas burners, sixteen on each side. These are staggered so that they fire both below the hearth and above the work—the latter burners firing tangentially to the arch of the roof. This affords free circulation of the hot gases, which is vital to uniform heating. The burners are manifolded to inspirators in groups of one, two, and three, and are so arranged that when the furnace has been brought up to heat in the shortest possible time, part of them can be turned off and only enough left burning to maintain the required temperature. The required temperature—1400 degrees F. in the hot zone—is maintained automatically by three recording controllers connected with motor-operated valves on the gas supply lines.

The furnace construction is of brick, 9 inches of firebrick with 9 inches of insulation being used in the hot zone, and 4 1/2 inches of each in the other two zones. The whole is encased in steel plates supported by double channel buckstay construction.

Fig. 3. Entirely Automatic Annealing Furnace for Wire Wheel Hub Parts

* * *

The financial plans of the steam railroads of the United States call for an expenditure of $1,050,000,000 during 1930 for new equipment and for improvements to railroad properties and permanent way. Of that amount, $370,000,000 will be spent for equipment and $680,000,000 for roadway and structures. It is estimated that $212,000,000 will be expended during the first quarter and $278,000,000 during the second quarter of the year. The development program for 1930 is the greatest in five years.

MEETING OF STEEL FOUNDERS' SOCIETY

The January meeting of the Steel Founders' Society of America, Inc., was held at the Hotel Sherman, Chicago, Ill., January 28. One of the subjects discussed was new applications for steel castings. Examples of how assembled parts have been successfully cast as a unit were presented. New applications of steel castings to replace weaker or less durable materials for specific purposes were also pointed out. With the rapid advancement in the art of steel casting, many new uses have been discovered which are not known to steel foundrymen generally; hence, at this meeting an effort was made to bring the experience of the entire industry to the attention of all the members.

On the day preceding the general meeting there was a meeting of the Cost Committee, who devoted the entire day to the work of developing uniform cost finding methods for steel foundries. The subject of repair and maintenance costs was thoroughly discussed and a paper on this subject was presented by C. A. McDonald, Nugent Steel Castings Co., Chicago, Ill. G. P. Rogers, 932 Graybar Building, New York City, is managing director of the society.

* * *

Whistles and bells may be a less disturbing factor in the noise and din of large cities if a larger amount of tin is added to the bronze in their manufacture, according to a statement made before the Institute of British Foundrymen by H. C. Dews. A bronze containing 25 per cent of tin, he said, gives bells and whistles a finer and softer tone, which is less offensive to the ear than devices made from a bronze containing a smaller amount of tin.

FIVE-OPERATION DIAL-FEED DIE

The lubricator compressor cap *B*, Fig. 1, is produced from the shell or cup illustrated at *A* in four drawing operations and one knurling operation, by means of the die equipment shown in Fig. 2. The operator merely loads the shells into bushings in an indexing dial plate which carries them into position above the different dies located in the bolster plate beneath the dial. In each of the drawing

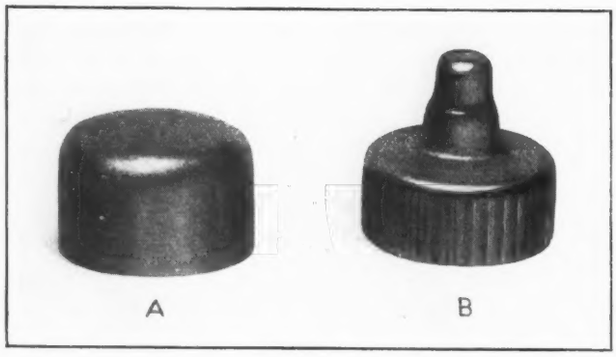


Fig. 1. Steel Shell before and after Going through the Five-operation Die Set Shown in Fig. 2

positions, a punch forces the lower end of the shell into the die, gradually working the part to the desired shape. This unusual equipment has proved itself capable of very high production at the Alemite Corporation's plant in Chicago.

Upon the return stroke of each punch, and before the indexing of the dial plate takes place, a knockout device comes into action, pushing the part up into the dial plate so that it can be carried to the next punch and die. The shell is held in the raised position by means of a spring-actuated ball which is provided in each bushing and which bears against the outside surface of the shell.

When the last punch and die are reached, the shell, now drawn to the finished shape, is pushed completely through the die. This die has a series of internal projecting blades that act as a broach and produce the straight knurling shown on the large cylindrical portion of the shell at *B*, Fig. 1.

Approximately forty of these compressor caps are produced per minute from 0.065-inch steel stock. At the beginning of the operation the shell is about 1 9/16 inches in diameter by 7/8 inch long, and when finished, it has been drawn to a length of 1 3/8 inches and has a maximum diameter of 1 1/2 inches.

* * *

To prevent vibration being transmitted to adjoining buildings, the Pittsburg Press has placed all its presses on large heavily reinforced concrete mats 12 inches thick, 60 feet wide, and 150 feet long. These mats, in turn, rest on a natural cork mat 1 1/2 inches thick, which absorbs the vibration.

CASTERS FOR MACHINE SHOP USE

Casters remained for many years about the same as when they first came into use, but recently they have been improved along the same lines as so many other machine details and devices. It was not, however, until industry in general began to use casters on all kinds of floor transportation devices that the inherent weakness of the old caster wheel became apparent. The constant pounding of the wheel under heavy loads and over rough floors proved too severe a test for the average caster wheel. They cracked and the rim of the wheel became scalloped. The sharp edges of the broken wheel would gouge holes in the floor, which, in turn, would bring about further wheel breakages and increase the exertion necessary to move the caster-mounted truck over the floor.

Then the pressed-steel wheel was introduced, with well rounded corners to eliminate cutting the floor, and anti-friction bearings, which permitted the caster to roll and swivel easily under any load. Gradually, every requirement in caster construction was met except the one of corrosion. In many plants, humidity and temperature conditions make for rapid corrosion. Under these conditions, casters are destroyed by rust long before they wear out. To overcome this difficulty, the Saginaw Stamping & Tool Co., Saginaw, Mich., has installed a complete Parkerizing equipment in which all caster parts made by the company are treated. The Parkerizing of steel parts prevents them from

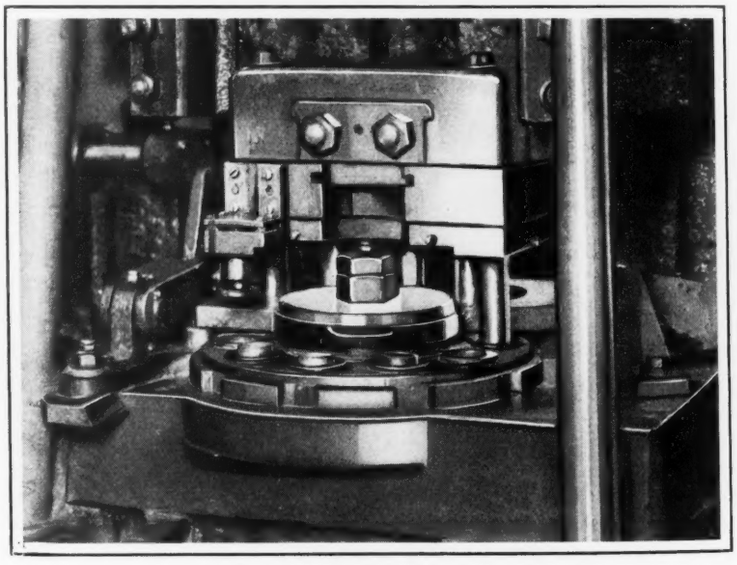


Fig. 2. Five-operation Die Set with Indexing Dial that Automatically Carries the Work from Die to Die

rusting and thereby increases the length of life of the casters.

It is of interest to note how the development of so comparatively small a part of machine shop equipment as the caster under the trucks used for moving materials from department to department has been subject to the same gradual evolution and taken advantage of the same highly developed processes in its manufacture as so many other products of industry.

LOCATING THE DECIMAL POINT IN SLIDE-RULE CALCULATIONS

By CHARLES B. IRMER

On page 46 of September MACHINERY is an article dealing with the rules for determining the position of the decimal point for slide-rule multiplication and division. These rules are similar, in general, to the instructions in the handbooks usually supplied with slide-rules by the manufacturers.

Twelve years of experience with the use of the slide-rule in engineering calculations have convinced the writer that there is less possibility of error in determining the decimal point, if all the so-called rules are discarded in favor of judgment and rational reasoning. For example, suppose that the following numbers are to be multiplied: $67 \times 15{,}365 \times 425 \times 0.0025$. Multiplying in the conventional fashion by using the C scale on the slide and the D scale on the rule, and disregarding the decimal point, the result obtained, is 1092. An inspection of these figures will show that they correspond approximately to $60 \times 500 \times 3/1000 \times 15{,}000$ which equals 1,350,000. The result of the first multiplication is therefore equal to 1,092,000, and the decimal point has been determined without the aid of any memorized rules. In addition, the slide-rule calculation has been checked roughly for correctness.

To the writer, this method of determining the decimal point seems much simpler than memorizing such rules as whether the slide is at the right or left, whether the particular operation is division or multiplication, together with the various exceptions to the rules fully outlined in the article in question. For efficient use of the inverse scale of the modern slide-rule, these rules must be modified, thus adding to their complexity and the possibility of error in their use. As far as the writer can determine from his contact with slide-rule users, the inverse or so-called CI scale on the standard Manheim slide-rule is seldom used in making multiplications and divisions. The inverse scale, as its name indicates, is simply the reciprocal of the numbers on the C scale of the slide. According to the usual methods of multiplying, the procedure for the example previously indicated is as follows:

1. Place the right-hand index of the C scale on 67 of the D scale.
2. Move the runner so that the hair-line corresponds to 15,365 on the C scale.
3. Move the C scale until the left-hand index corresponds to the hair-line on the runner.
4. Move the runner until the hair-line coincides with the point 425 on the C scale.
5. Move the C scale until the right-hand index coincides with the hair-line of the runner.
6. Move the runner until the hair-line corresponds to the number 0.0025 on the C scale, when the answer, 1,092,000, will be read on the D scale, the decimal point being determined either by the conventional rules or the method previously described.

An inspection of the previous multiplication will show that it is equivalent to the following:

$$67 \times \frac{1}{(1 \div 15365)} \times 425 \times \frac{1}{(1 \div 0.0025)}$$

As the value of the fractions $\frac{1}{15365}$ and $\frac{1}{0.0025}$ can be read directly on the C scale by projecting down from the numbers 15365 and 0.0025 on the CI scale, the procedure for multiplication, using the inverse scale, is as follows:

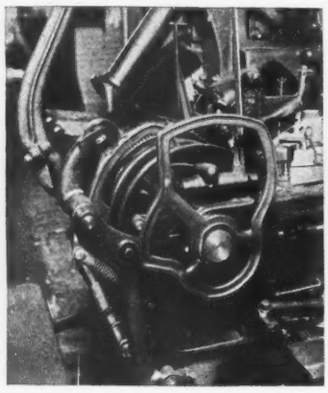
1. Move the slide until the number 15365 on the CI scale coincides with 67 on the D scale. The left-hand index of the C scale then indicates on the D scale the value of the division $\frac{67}{1 \div 15365}$ which is equivalent to the product 67×15365.
2. With the slide in the given position, move the runner until the hair-line coincides with the number 425 on the C scale. This operation multiplies the result of Operation 1 by 425, the product being indicated by the position of the hair-line on the D scale.
3. Move the slide until 0.0025 on the CI scale coincides with the hair-line on the runner. The answer, as read at the left-hand index of the slide, is 1,092,000. In this way, the product of Operation 2 is divided by $1 \div 0.0025$, which is equivalent to multiplying by 0.0025.

It will thus be seen that with the inverse scale, it is possible to complete in three operations a multiplication that requires six calculations by the use of the C and D scales alone. This is true, in general, for division and combinations of multiplication and division. If, however, an attempt is made to use the inverse scale in the manner indicated and then determine the decimal point by the application of the previous rules, obviously there must be considerable revision in those rules before they can be applied to this method.

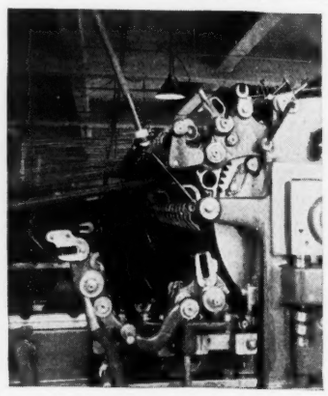
The writer realizes that, in discussions of this nature, much depends upon the personal opinion of the reader. To those who have used what might be called the "rule method" for the determination of the decimal point, the method here presented may seem to offer possibilities of error because of the mental work involved. However, the writer believes that any user of the slide-rule who will try the method described, will agree that it is more efficient, simpler, and generally more correct than the method usually employed.

* * *

Truck production increased 40 per cent in 1929 as compared with 1928, 805,000 trucks being produced in 1929 and 576,500 in 1928. Light trucks were especially in demand, vehicles of one ton and under accounting for 75 per cent of the total production. The sales of trucks in foreign countries increased from 209,500 to 345,000. Over 7000 trucks are used today by railroads to eliminate train service in terminal areas and for short haul traffic. One railroad has established a large-scale truck transportation system and hauls freight to 200 Minnesota and South Dakota towns by truck.



Ingenious Mechanical Movements



HIGH-SPEED INTERMITTENT MOTION

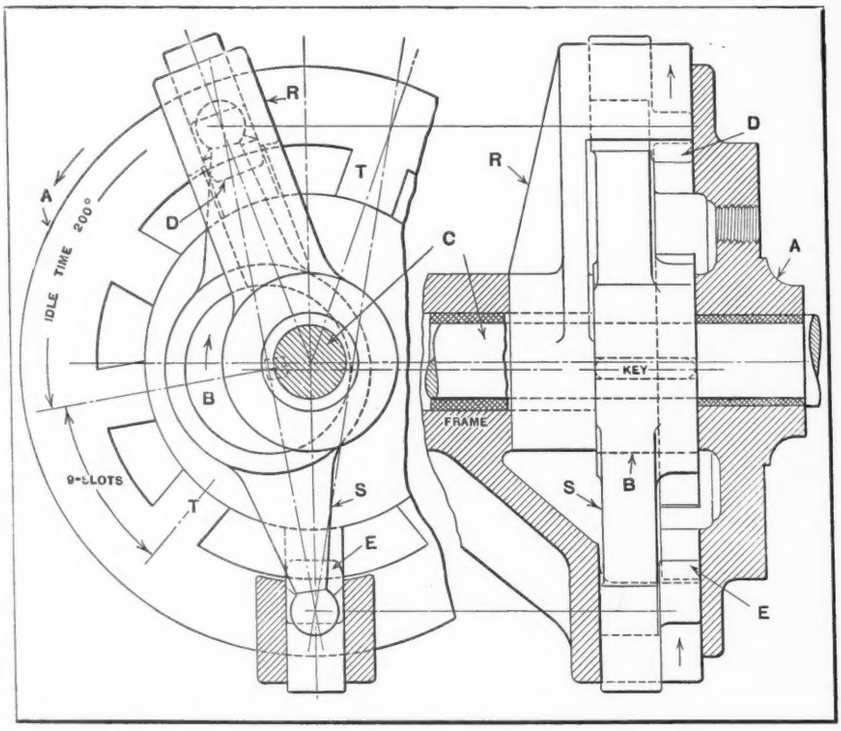
By RALPH A. GLEASON

An intermittent rotary motion mechanism similar to the one shown in the accompanying illustration, but suited for use where the idle time is short, as compared with the movement or feeding time, was described in January MACHINERY, page 380. The total idle time between the rotary or feeding movements in the case of the mechanism here described is equivalent to more than 180 degrees per revolution, while in the case of the previously described mechanism it was less than 180 degrees.

The principal difference in the designs is found in the location of the actuating teeth *D* and *E* in relation to the member *A* to which the intermittent or indexing motion is imparted. In the mechanism previously described, these teeth were located on the inner side of the annular ring in which the indexing slots *T* are cut.

In the mechanism described here, the actuating teeth operate on the outside of the slotted ring of member *A*, so that the idle time occurs while the eccentric throw travels above the center line during the return stroke of strap *S*. The forward or feeding movement, therefore, occurs while the eccentric throw travels below the horizontal center line. With this arrangement, the longer throw of the eccentric is utilized for the idle or return movement of arm *S*, while the shorter throw is employed for the feeding movement. It will be noted that the shaft and its eccentric driver *B* rotate in a direction opposite to that of the driven member *A*, whereas in the design previously described, these members rotate in the same direction.

When the mechanism is in operation, the central shaft to which the eccentric driver *B* is keyed rotates at a constant speed. The lower end of the strap *S* is restricted to a vertical motion by the tooth *E*. Tooth *E* is pivotally mounted on strap *S*, having a wide bearing on the strap, and slides freely in a groove in the rigid frame. The tooth *D* at the opposite end of strap *S* has a similar pivoted connection to the strap and slides freely in a groove cut in the radial rocker guide *R*, which is a free turning fit on the central shaft bushing. The guide rocker *R* serves to maintain the tooth *D* in a radial position with respect to the central shaft. When the mechanism is in operation, the eccentric *B* causes the teeth *D* and *E* alternately to engage and disengage the equally spaced slots *T* cut in the annular ring and produces the intermittent motion of member *A*.

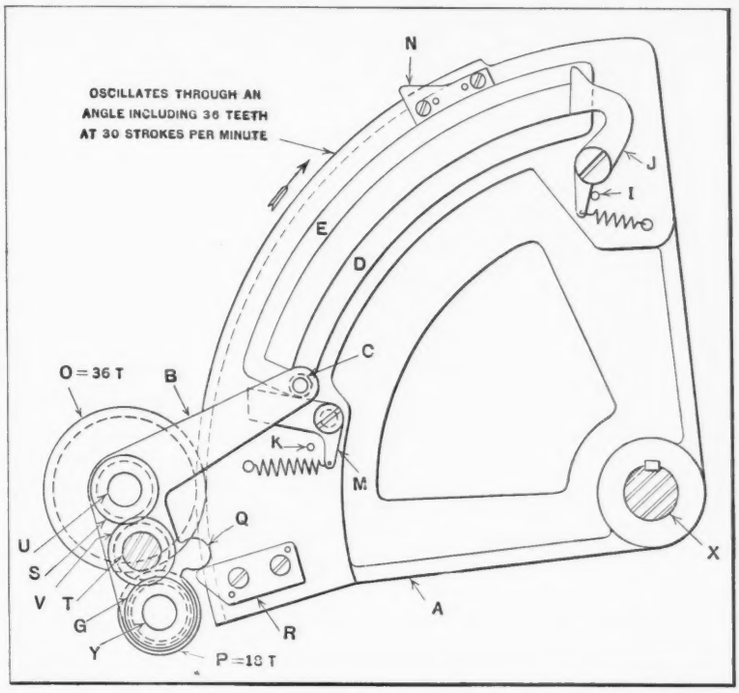


Mechanism by which Constantly Rotating Eccentric B Keyed to Shaft C Imparts Intermittent Motion to Member A

The vertical motion of the bottom end of the strap *S*, combined with the rotary motion at the cen-

ter imparted by the eccentric *B*, gives the top end of the strap carrying tooth *D* a peculiar elliptical motion. This motion is such that tooth *D* alternately engages and disengages successive slots *T*, thereby imparting the required intermittent motion to the driven member *A*. The length and shape of the teeth are such that either or both teeth are always in engagement with slots in member *A*, thus giving a positive control over the motion. Tooth *E* locks the part *A* in position while tooth *D* is on its return or idle stroke. Tooth *D* engages a slot preparatory to the forward movement before the locking tooth *E* is disengaged. The hub at the right-hand side of member *A* is provided so that a sprocket or gear can be attached to it, through which the motion is transmitted to other parts.

This mechanism has several desirable characteristics, such as its slow starting and stopping action, absence of over-throw, positive locking between movements, compactness, and ability to operate in either direction. It can also be operated at relatively high speeds. The idle time is determined by the number of slots, and is always equivalent to more than 180 degrees per revolution. With nine slots, as in the design illustrated, the idle time is 200 degrees per revolution. With fewer slots, the idle time would be greater, and with a greater number, the idle time would be less. For the best action, there should be an odd number of indexing slots.



Mechanism for Converting Oscillating Motion into Reversing Motion

OSCILLATING MOTION CONVERTED TO VARIABLE REVERSING MOTION

By J. E. FENNO

In a special electrical switch testing machine, an oscillating motion of one shaft is converted to a reversing motion in another shaft, the latter alternating at each reversal between the two speeds of 60 and 30 revolutions per minute.

The shaft *X*, on which the segment gear *A* is keyed, is the oscillating member. The shaft *T*, to which the irregular motion is transferred, turns in the machine bearings (not shown) and serves as a pivot for the arm *B*. Gears *O* and *P*, located under this arm, are keyed on shafts *U* and *Y* and are connected by the three gears *S*, *V*, and *G*. The concentric grooves *E* and *D*, milled in the segment gear, are joined at both ends to form one continuous groove and serve as a guide for the cam-roll *C* in the end of arm *B*. Dogs *R* and *N*, which engage projection *Q* on the arm, are fastened securely to the segment gear. Latches *J* and *M* swing on shoulder-screws, and normally bear against pins *I* and *K*, due to the tension of the coil springs.

In the position shown in the illustration, the segment gear *A* is oscillating in the direction of the arrow, and the dog *R*, against lug *Q*, is about to swing the arm *B* around shaft *T*. A further upward movement of dog *R* will throw gear *O* out of engagement with the segment gear. However, just before the teeth of gear *O* have become disengaged, a partial engagement of the teeth in gear *P* and segment *A* takes place. While gears *O* and *P* are being shifted, roller *C* swings up to the beginning of the groove *E*. When the roll reaches this position, the oscillating segment *A* has come to the end of its upward stroke and is about to return. The latch *M* closes the end grooves and prevents the roll from dropping back to groove *D* when the segment reverses.

The roll now follows groove *E* and serves to hold gear *P* in mesh with segment *A* until dog *N* comes in contact with the lug *Q*. This disengages gear *P*, after which gear *O* is engaged with segment *A* again. In the meantime, roll *C* has forced latch *J* to one side and is swung down to the end of groove *D*, being prevented from coming out of this groove by the return of latch *J*. The roll, running in groove *D*, serves to hold gear *O* in mesh during the return stroke of the segment. This completes one cycle of the movements.

Because of the difference in the number of teeth between gears *O* and *P*, as noted in the illustration, and the arrangement of the gear train, the uniform oscillation of segment *A* will result in one clockwise revolution of shaft *T* for every up stroke of the segment, while the down stroke will result in two counter-clockwise revolutions of the shaft.

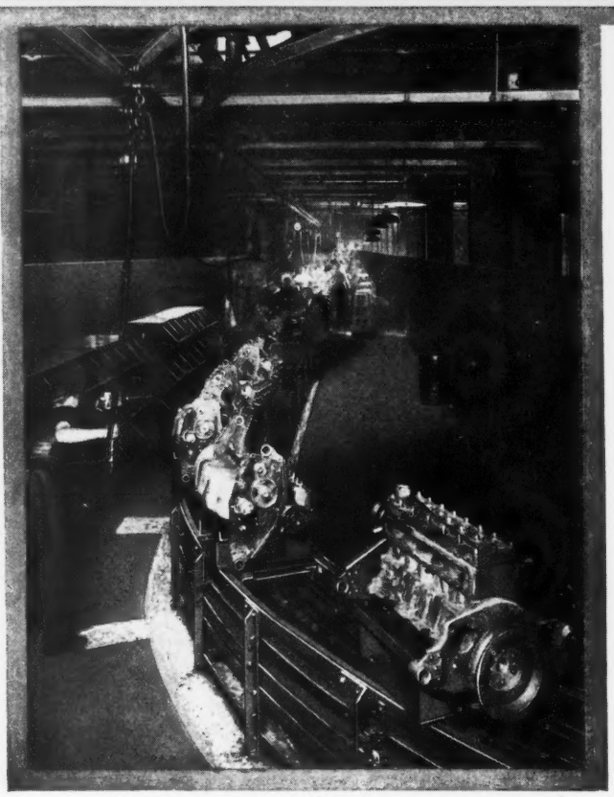
With some slight modifications in the design, shaft *T* may be made to revolve at varying speeds other than described and in the same direction instead of reversing. This may be done by varying the number of teeth in the gears and adding an idler between any two of the gears *S*, *V*, or *G*.

Continental Motors Plant Reorganized for Maximum Efficiency

WHEN a manufacturing plant has had a rapid growth, the arrangement of the machine equipment and the work-handling facilities employed are often the result of more or less emergency measures taken to meet constantly mounting production requirements. Consequently, the efficiency of the shop is usually less than it would be if the plant could have originally been planned with an understanding of future requirements and production methods. The management generally realizes the situation, but tolerates it because of the belief that the cost of extensive changes in methods would be exorbitant.

Until recently, this condition existed to some extent in the Detroit and Muskegon plants of the Continental Motors Corporation because of their rapid development in line with the growth of the automobile industry. However, both plants have been completely rearranged within the last few months on a scientific basis which has greatly reduced the work-handling problem, eliminated the storage of parts in process, and increased the general efficiency. The remarkable part of this achievement is the fact that the savings made in the transportation of work alone will in one year more than cover the entire cost of rearranging the shop. Furthermore, the complete change-over was accomplished with only a negligible falling off in production.

This article will deal specifically with the changes made in the Detroit plant. Previously, all finished parts were trucked to a central stores, checked in, and stowed away until required by the assembly division. Then the parts were checked out and transported to the assembly lines. This work has now been completely done away with. Other outstanding changes include the provision of equipment that enables parts of different sizes to be produced on the same machines and the standardization of many parts to secure interchangeability on various engine models.



One Conveyor on which Thirty Different Engines are Assembled is Fed Directly from the Machine Lines

All Work Fed Direct from Machines to the Assembly Conveyor

The manufacturing problems in this plant differ materially from those of other automobile shops owing to the fact that from twenty-five to thirty models of engines are generally being built at one time. Some of these vary only in minor details, whereas others are radically different. The plant has been rearranged so that all models can be assembled along a single conveyor which runs the entire length of the shop directly in the middle. The various machine lines are so grouped on each side of the conveyor that the different engine parts reach it exactly in the locations where they are needed in the process of assembly.

Partitions on each side of the conveyor, as shown in the heading illustration, isolate it from the remainder of the shop. These partitions prevent the space adjacent to the conveyor from becoming clogged up, and promote cleanliness. Also, persons not actually engaged in assembly work are kept away from the line, and at night the entire department can be locked up.

The different engines are sent along the conveyor in lots according to a schedule posted on a bulletin board at noon of the previous day. For instance, the schedule may call for 90 engines of Model 14M to be followed by 5 of 14K, 15 of 11E, 5 more of 14K, and so on. Five hundred motors can be assembled per day.

At the starting end, the conveyor is of the ordinary roller type, along which the cylinder blocks are pushed by hand during the assembly of prelim-

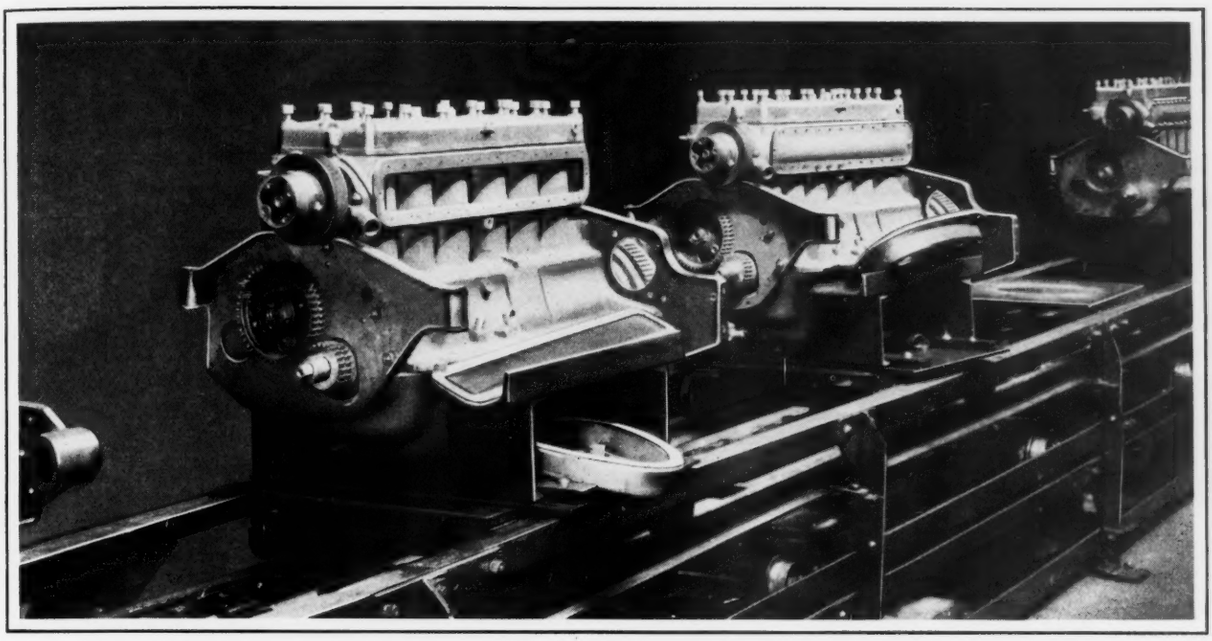


Fig. 1. Conveyor Carriages with Partially Assembled Automobile Engines on Them

inary parts. Then the blocks are placed on carriages, as shown in Fig. 1, which automatically transport the engines a distance of about 500 feet to the discharge end of the conveyor. The carriages are spaced approximately 5 feet apart. They are designed so that the engines can be easily swiveled horizontally, and the engines may be placed on the carriages in any position to suit the convenience of the assemblers.

Bins located along the conveyor, as shown in the heading illustration, contain studs, spark plugs, and other small parts or units. Major parts reach the conveyor by various means; for instance, the cylinder blocks are delivered to it by overhead hoists, while the camshafts are brought by the conveyor illustrated in Fig. 2. This conveyor first carries the camshafts to all the machines employed in their production, and then runs through a narrow slot in the partition on one side of the conveyor and delivers the camshafts to the man who puts them into the engines. The truck seen in this illustration is used for storing away a small number of camshafts to await the particular engine models for which they are intended. Crankshafts, piston

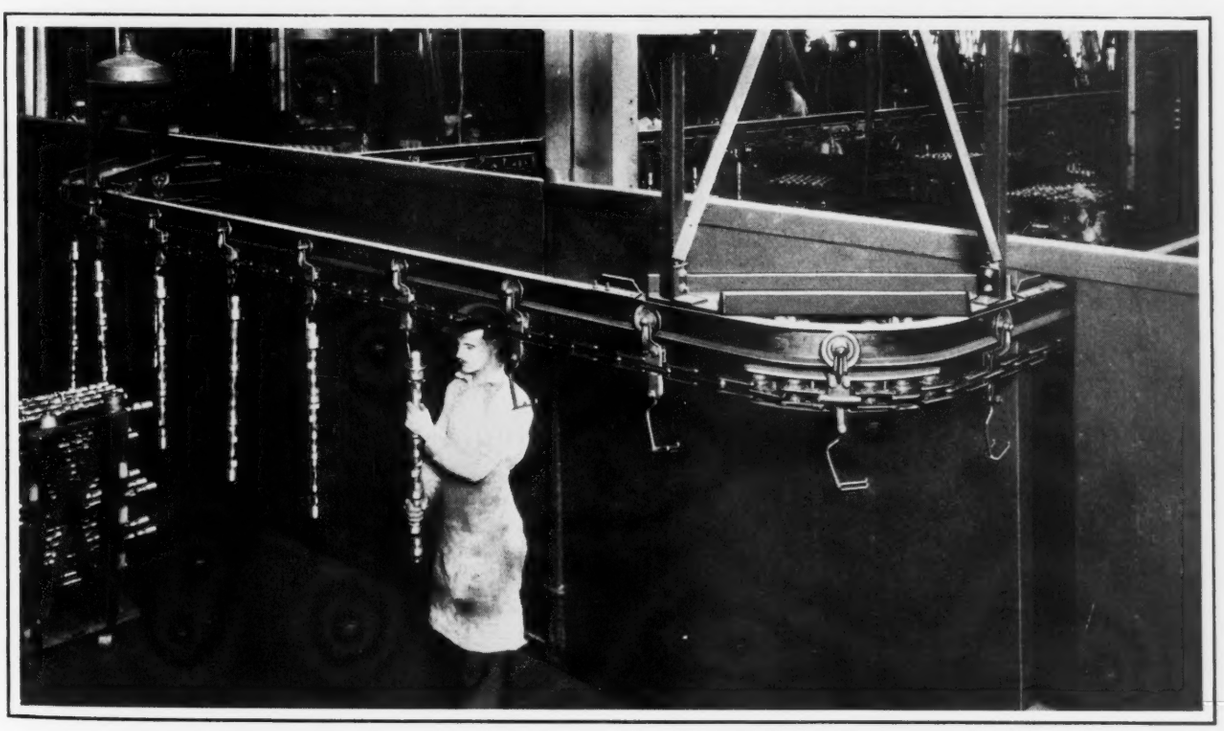


Fig. 2. Assembler Removing Camshafts from a Conveyor which Extends the Entire Length of the Camshaft Department

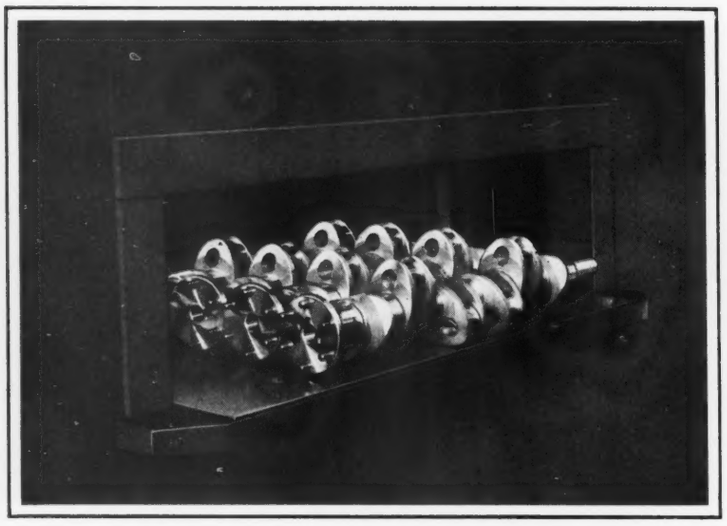


Fig. 3. Typical Opening in Conveyor Partitions through which Various Parts are Passed to the Assemblers

and connecting-rod units, and other parts are passed to the assemblers through openings in the partitions, such as illustrated in Fig. 3.

From the Conveyor the Engines Go Direct to Test Blocks

As the engines reach the completely assembled state, an eyebolt is screwed into one of the spark plug holes and the entire unit removed by an overhead crane. Three cranes are used to take the engines direct from the conveyor to running-in stands extending in parallel rows from the discharge end. There are approximately 500 stands in this department.

Several thousand machine tools had to be shifted to place all machine lines at right angles to the assembly conveyor in the desired sequence. This was accomplished with an inconsequential production loss by moving only one machine of a given line at a time, keeping it in production until immediately before it was moved, and starting it up again just as soon as it was installed in the new place. Machines were also shifted while the plant was shut down at night and over Sundays. The actual shifting of the machines was completed in approximately fifteen days, although the planning covered a period of months.

Tool Flexibility Permits Use of Same Machines for Parts of Different Sizes

With the large number of engine models built in this plant, it was obviously desirable to provide for changing over machines quickly to permit manufacturing similar parts of different sizes on the same machines. In the cylinder block department, one line of machines must be frequently rearranged to handle five different blocks. Matters have been simplified considerably by providing different fixtures for each job. These can be set in place quickly and the tools adjusted by means of reference pads milled on the fixtures.

Extra cluster heads, with the spindles set to suit certain jobs, are provided for the different multiple-spindle drilling machines, so that when a major job change is being made, complete cluster heads are substituted for those on the machines, so as to avoid the troublesome resetting of spindles. In some cases, a few drills are merely removed and others supplied.

In the crankshaft department, the tooling of every machine can be changed in eight hours to handle either eight-throw or six-throw crankshafts, as required. Altogether there are 219 machines which must be changed over, and the allowance for doing this is only $60. The department continues in operation during the making of such changes, the machines being altered successively as the last crankshaft of the previous lot leaves them.

The Wickes crankshaft lathes used in this department are provided both at the front and rear with an angle casting *A*, Fig. 4, the top surface of which is inclined 30 degrees. The tool-blocks are fastened to these castings by means of T-slots, and can, therefore, be easily moved lengthwise of the machine, as well as in and out, to suit different crankshafts. Spacers are supplied for the pot chucks so that they can be set according to the crankshaft length, and the steadyrests provided on some machines are equipped with adjustable jaws.

In the piston department, interchangeable tool-blocks, such as shown at *A*, Fig. 5, enable the Fay

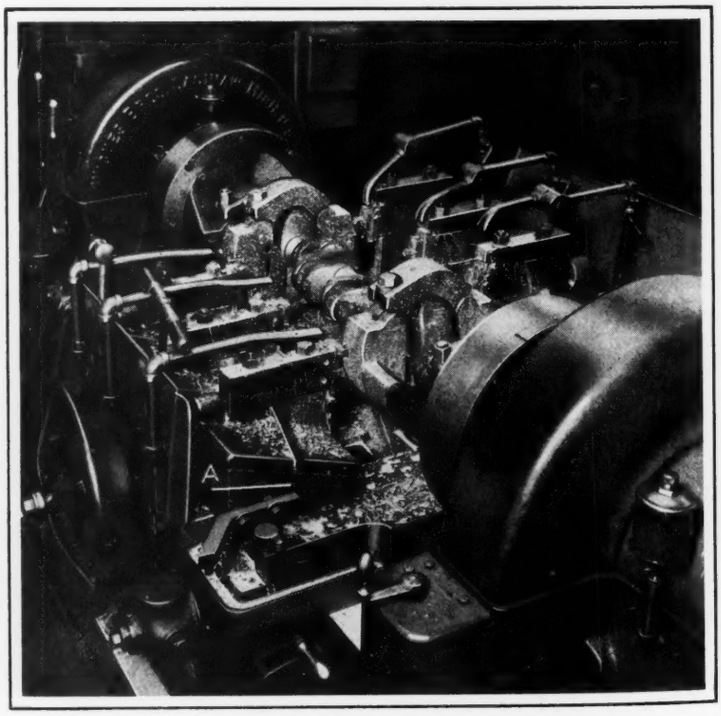


Fig. 4. Crankshaft Lathe Provided with Tooling Designed for Flexibility

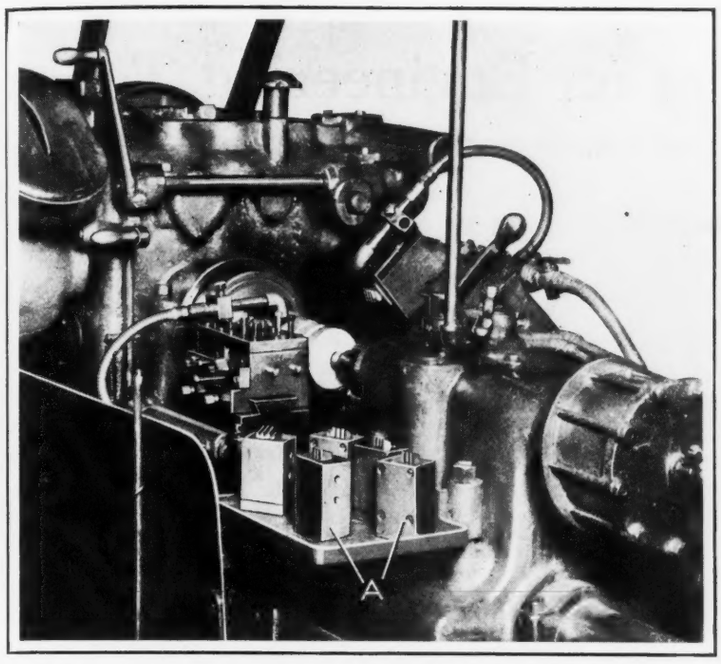


Fig. 5. Piston Grooving Machine Supplied with Interchangeable Tool-blocks for Handling Different Sizes of Work

automatic lathes to be changed over quickly for handling different pistons. The tools are positioned accurately in these blocks as required for their respective jobs, and so any set-up can be quickly arranged by merely inserting the blocks in their holders and adjusting the carriages. The operation illustrated consists of cutting the ring grooves.

Camshaft producing machines are equipped with different steadyrest rollers to suit various camshafts, and the carriages and tools can be easily positioned lengthwise and in or out, as required.

Checking the alignment of connecting-rod and piston assemblies for different engines is facilitated by the large indexing arrangement shown in Fig. 6. This device has six tables, on each of which an aligning fixture is mounted, as indicated at *A*. When the checker wishes to use any particular fixture, he depresses a foot-treadle to release the table or shelf at his waist, and then revolves the device until the table he wants reaches him.

While all the machine lines have been equipped for handling parts of different sizes, it is obviously most desirable to maintain each set-up as long as possible. For this reason, the parts have been standardized to permit the use of one part on as many engines as practicable.

* * *

If business activity can be measured by car loadings of revenue freight, the present index of car loadings is encouraging; for while the loadings are running below the peak of a year ago, they are running much further ahead of the loadings of two years ago than they are below those one year back.

THE GERMAN MACHINERY INDUSTRY

According to a report by Trade Commissioner James E. Wallace, Jr., of Berlin, Germany, the German machinery industry, which enjoyed a comparatively favorable business during the first six months of the year, suffered a setback during the latter part of 1929. There appears to be a general feeling that one of the principal reasons for this unfavorable change was the shortage of capital in Germany. As a direct result of this, there has been a decrease in the machinery sales in the domestic market.

Measures for relief from taxation and other burdens borne by the machinery industry in Germany are being urged, and there is also a general feeling among German machinery manufacturers that important changes must be made in the organization of the industry before any real improvement in the present unsatisfactory condition can take place. There is at present far too little specialization. Instead of producing one line of machinery on a production basis, German manufacturers have a tendency to enter on too varied a program. In fact, whenever there is a demand for some particular type of machine, a large number of manufacturers immediately begin building it, and overproduction is the result within a short time.

The German Machinery Manufacturers' Association is doing a great deal to bring about a reduction in production costs through specialization and cooperation between manufacturers.

Fig. 6. Indexing Arrangement which Facilitates Aligning Connecting-rod and Piston Assemblies

Notes and Comment on Engineering Topics

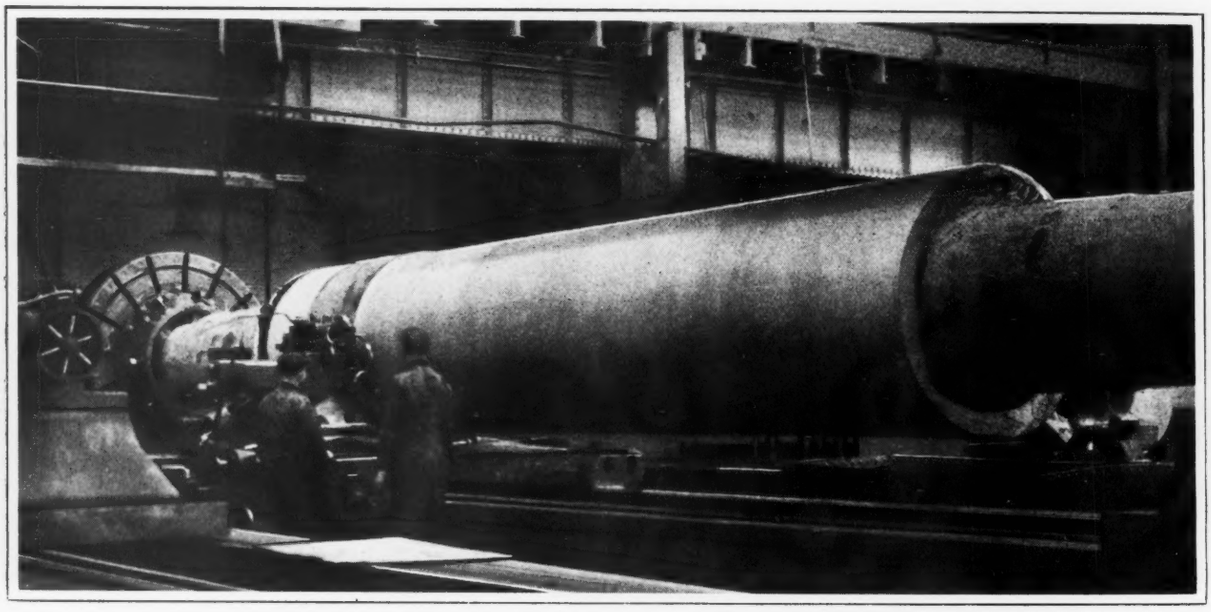
It is reported that the Zernotrest, Soviet Russian wheat trust, has recently purchased 1300 tractors and 750 combined harvesters from the Caterpillar Tractor Co. This machinery is valued at $7,000,000.

An interesting application of the photo-electric tube or the so-called "electric eye" has been made at the Museum of Peaceful Arts, 24 W. 40th St., New York City. Visitors to the museum, as soon as they step from the elevator into the great room housing the exhibits, are greeted by the words "Will you please register?," but no person is in sight. The speaker is a record disk in a small box, the record starting as soon as anyone stepping out from the elevator passes through a beam of light.

With more than 10,000 miles of airways and about 260 intermediate landing fields provided with guide beacons and ground lighting, the United States Department of Commerce has found it possible to decide on definite standards for airway and airport lighting systems. It is expected that more than 2000 miles of additional airways will be provided with this standard equipment during 1930.

During the twelve months ending June 30, 1929, eighteen ocean-going vessels of 10,000 tons and upward were completed throughout the world. Only six of these were steamships and twelve were motor ships. Two of these were 24,000 and 20,000 tons, respectively. The number of all the new ocean-going ships built was 547, and their gross tonnage was 1,748,500. Of this number, fourteen ships, with a gross tonnage of 167,000, were equipped with steam turbines, and 170 ships of 786,000 tons, or close to 45 per cent of the total tonnage built, were furnished with internal combustion engines—generally Diesel engines.

A Westinghouse synchronous motor, which is used to drive a 22-inch continuous bar mill, is said to be the largest diameter synchronous motor in operation. It is 25 feet in diameter and has an output of 5000 horsepower at 82 revolutions per minute. The motor has 88 poles and operates on a three-phase, 2200-volt, 60-cycle system at 100 per cent power factor. This installation is in the mills of the Columbia Steel Corporation at Pittsburgh, Calif. A duplicate motor is being installed to drive a continuous billet mill. The steel rolled by these motors is used for making tin cans.



A Steel Forging for a 115,000-kilowatt Allis Chalmers Turbo-generator. The Forging is 42 Feet in Length and Weighs 269,000 Pounds

A 135-TON STEEL FORGING

The illustration shows a steel forging, 42 feet in length, weighing 269,000 pounds, which is used for the rotor of a 115,000-kilowatt Allis Chalmers turbo-generator. The photograph was taken in the plant of the Midvale Steel Co., Philadelphia, Pa., where the forging—one of the largest steel forgings ever made—was produced. In rated output, the turbo-generator for which this forging was made will be one of the two largest generators ever built. It will be installed in the Waukegan Plant of the Public Service Co. of Northern Illinois.

Testing Welds for Strength and Quality

Methods of Applying Destructive and Non-destructive Tests, Including Tensile, Bend, Hydrostatic, and Stethoscopic Tests

THE most common method of determining the strength and quality of welds is to select samples that are assumed to be representative of the material welded and subject these to destructive tests. Such tests may be supplemented by non-destructive tests to ascertain the kind of workmanship or quality of the weld. Among the destructive tests, the oldest and most extensively used is the static tensile test. When applied to welds, this test has certain limitations, and, therefore, additional tests are applied to supply more complete information. The most valuable of these is the bend test, which will be described later.

Tensile testing of a weld consists of producing failure in the welded specimen by applying a measured load. The sample is usually taken with the weld located at the center, and it conforms to the American Society for Testing Materials standard for flat specimens. The pieces, often termed coupons, are either made up specially for the tests or taken from a finished structure. The flat specimen is entirely suitable for testing butt welds, but in the case of lap or fillet welds, the condition of elementary tensile stress is complicated by the bending stresses due to eccentric loading. The round type of specimen is not satisfactory, because it could not include the entire irregularly shaped weld and the results would not be representative.

The welding reinforcement may be removed or not, depending upon the information sought. If the reinforcement is ground off, the unit strength of the weld can be determined, provided failure occurs in the weld. If the reinforcement is not removed, the test will determine whether the weld is stronger than the base metal, and it will reveal the strength of the joint as a whole. In the case of a double V-weld, the reinforcement on the two sides will be near enough alike so that the matter of bending stresses and complicated stress distribution need not be considered, but in single V-welds, the contour of the specimen as affected by reinforcement is important.

In addition to the ultimate strength, other factors are generally measured when carrying out the tensile test, namely yield point, elongation, and reduction of area. The exact value of the yield point of the weld metal is very difficult to determine, because it is different from that of the base metal, and over any reasonable gage length, a combination of weld metal and base metal exists. Thus the weld metal is apparently either weakened or reinforced by the base metal when it begins to yield.

In the usual tensile test, the percentage of elongation and of reduction in area, both of which are dependent upon the ductility of the metal, are determined; but when a welded specimen is loaded in the tensile testing machine, the load causing fracture is not great enough to produce much elongation of the weld metal, and the effect on the deformation of the specimen is much the same as would be the case if the material were of uniform strength and yield point and the specimen had an increased cross-sectional area at the center. The measurement of elongation in 2 inches across the fracture outside the weld in the base metal naturally gives no information about the weld.

In this discussion of elongation, the weld metal and base metal have been considered of equal section, and if the weld is reinforced, the shoulder effect at the center of the specimen is merely accentuated. If the weld is free from defects and made of material weaker than the base metal, then the elongation in 2 inches across the unreinforced weld will give some information about the ductility of the weld metal. This is only qualitative, however, as most of the gage length is made up of base metal and either one or the other of the materials will do more of the stretching. If failure of a specimen occurs on account of serious defects, the tensile test becomes merely the means of determining the quality of the workmanship, and the values for elongation and tensile strength vary together and are reduced in proportion to the extent of the defect.

Until recently, tensile testing has been largely confined to the laboratory or large mill. On account of the great weight and cost of most tensile testing machines, they are not available for testing in the field or in the smaller welding shops. These difficulties have now been overcome by a portable tensile machine developed by the Union Carbide & Carbon Research Laboratories. This machine, which is shown in Fig. 1, weighs only approximately 200 pounds, although of 40,000 pounds capacity.

The object in testing welds is to determine how the material in the weld compares with a similar material that has given satisfactory service. The most common method of securing such information is to select samples that are assumed to be representative of the entire material and subject them to destructive tests. Tests of this general class are used to determine the properties of the weld, and they may be supplemented by certain non-destructive tests for ascertaining the kind of workmanship or the quality of the weld. Important facts relating to various classes of tests were given in a paper entitled "Destructive and Non-destructive Tests of Welds," presented at the annual convention of the International Acetylene Association by J. R. Dawson and A. G. Kinzel of the Union Carbide and Carbon Research Laboratories. In the present article the more important points referred to in this comprehensive treatment of the subject are dealt with.

It is apparent that by the tensile test, information about the strength of the joint as a whole is obtained. In this way, both the properties of the materials and the quality of the workmanship can be determined. This test is the mainstay of the welding engineer in that it gives him assurance that joints of the required strength are being produced. It is unfortunate that the test gives less information about ductility of welds than about ductility of materials in specimens free from joints. In order to give the engineer the same information about welds that he usually obtains about other metal construction materials, ductility must be reported quantitatively, and for this reason the bend test must be included in any study of welds.

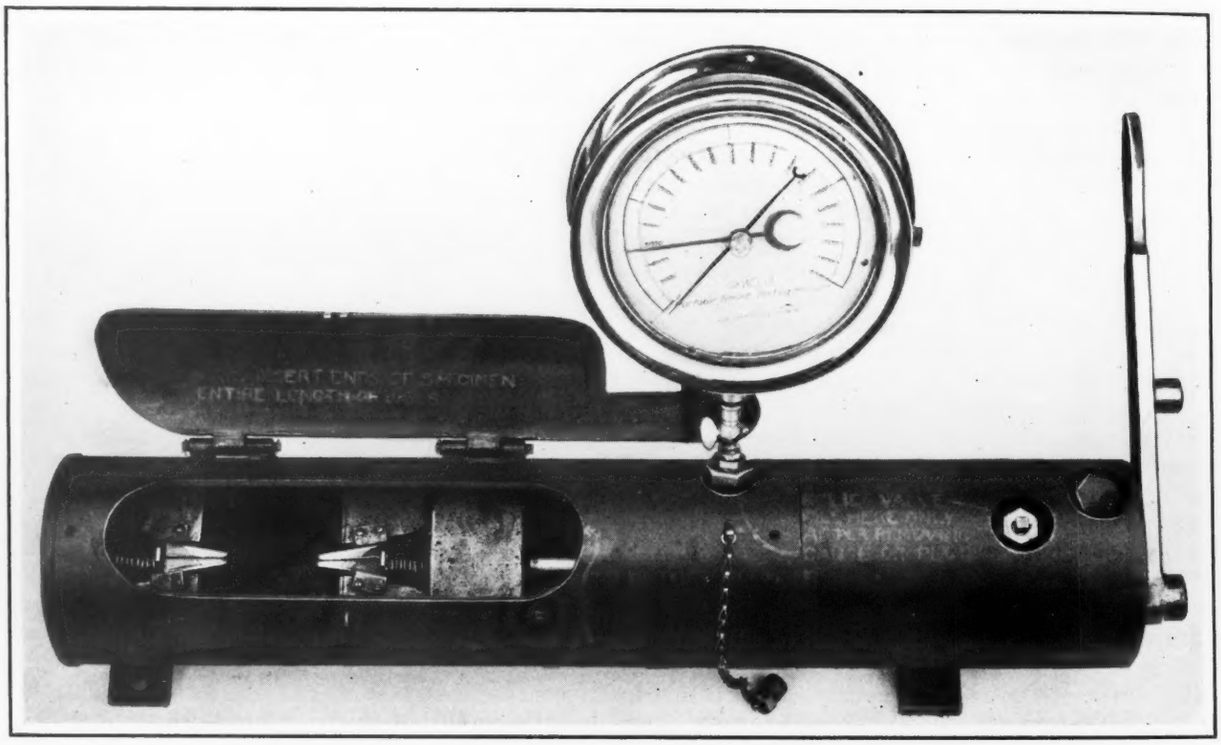


Fig. 1. Portable Tensile Testing Machine Weighing 200 Pounds and Equipped with Direct-reading Gage for Loads up to 40,000 Pounds

Bend Testing to Determine Ductility of Weld

There are two important reasons why the bend test has been greatly needed and is now being so universally adopted. First, it is a quick means of testing, requiring no special apparatus, and second, the information regarding ductility of a welded specimen as determined in the usual tensile test is unsatisfactory. The bend test is probably the oldest means of investigating ductility, but its application until quite recently has been entirely qualitative. A method of bending known as the quantitative free bend test is based on the fact that the performance of the material in bending is measured by the amount of stretch in the outer fibers at the instant of failure.

In carrying out the bend test, the ends are bent slightly; then by means of a vise or press, the specimen is subjected to compression as a Euler column. Under these conditions, no extraneous strains are produced at the point of maximum bending, and both from a theoretical standpoint and as the result of much experience, this type of test proves to be the only bend test now generally available that can be considered satisfactory for a welded specimen. The stretch in the outside fibers of the weld material is measured either with a flexible rule between previously located gage marks or by means of a bend extensometer. The use of a heavy press or the tensile testing machine is desirable for specimens 1/2 inch or more in thickness. Very little work has been done on bending at high temperatures. This is important in some applications, for certain materials lose their ductility at moderately elevated temperatures. The nature of the test is such that it may be carried out readily at high temperatures.

Fatigue, Izod, and Hardness Tests

The fatigue test is rarely, if ever, applied in the routine testing of welds. The reasons are that serious defects are discovered readily by means of the tensile and bend tests, which are less expensive and more quickly applied; however, the fatigue test, intelligently carried out and applied, is useful in research work. Care is necessary in the use of this test and in the interpretation of the results, because the endurance value is so greatly affected by the surface condition of the specimen. The best type of fatigue test is actual service, such as has been given by hundreds of pressure vessels which have been in continuous operation for many years without any known failure on account of fatigue.

What has been said about fatigue testing applies as well to the testing of shock resistance. The Izod

or other notch impact tests are not used extensively, because the preparation of the test specimens is rather expensive, and because, for routine testing, the simpler test gives sufficient information; moreover, only one point is really tested in this way. From a research standpoint, valuable information about the shock resisting properties of various weld metals is obtained by means of the impact test.

Another type of test useful in research work but not suitable for routine application consists of a hardness exploration of the weld and adjacent base metal. This may be carried out with the Rockwell cone tester or any other tests giving local readings. The information obtained by the use of this method is particularly valuable in cases where the weld or base metal consists of alloy or high-carbon steel.

Hydrostatic Non-destructive Testing

The first non-destructive test applied to welds was the hydrostatic test of structures that were either closed or that could be closed readily so that the test could be applied. For open construction, such as bridges or buildings, the counterpart of this test is obtained by the measurement of deflections as the structure is completed or when it is subjected to live loads. In the hydrostatic test, some pressure in excess of the working pressure, but appreciably below the yield point of the material of the vessel, is used to detect gross defects that would cause failure. However, with welding at its present stage and with carefully worked out procedure controls, the probability of defects serious enough to be discovered by the hydrostatic test is extremely small. Because of the improvement of control and quality of welds, and the correspondingly improved properties demanded in welds, a greater degree of sensitivity in testing is required.

A special type of hydrostatic testing is the breathing test. For example, a welded vessel would be subjected to 10,000 reversals of stress ranging from one and one-half times the working pressure to zero. It is possible that certain defects would be found in this way. It is also possible that strained areas would develop minute cracks under this treatment which would never have been produced in regular service. These cracks are ideal starting points for corrosion fatigue in service and might well lead to serious cracks and failure. For this reason, the breathing test for regular application to welded boilers or pressure vessels would seem to be undesirable but, of course, valuable information might well be obtained with this type of test, provided it is regarded as a destructive rather than a non-destructive test.

Use of Stethoscope for Non-destructive Test

The great need for a non-destructive test in which the weld is not strained is evident, and it is further evident that this test may be confined entirely to the workmanship, for if the workmanship is good, it is apparent that the welded structure will have the same properties as the samples used in the destructive test. The stethoscopic test is a unique method in which the stethoscope so much used by the physician is employed.

Fig. 2 shows an operator applying the stethoscope to a small tank. It has been found that by placing the end piece of the stethoscope near the weld and tapping with a hammer along the weld, discontinuities may readily be detected, which makes the process extremely simple. The stethoscope is tipped with a gum rubber cap to exclude extraneous sounds and give a contact on the irregular surface of the plate, as well as to minimize damping of the oscillations at the contact of the stethoscope and metal.

Fig. 2. Use of Ordinary Physician's Stethoscope for Locating Possible Defects in Weld by Noting Any Variation in the Normal Sound while Tapping with Hammer along Weld

On tapping, the initial sound heard is critical. Each welded structure has a characteristic sound. After this is determined by brief preliminary tests, differences in sound as the hammer is applied to the weld may be noticed readily. The method has been applied to welds in steel plates, pipe welds, pressure vessel welds, and welded structural steel joints. It has been found that defects that impair the strength of the weld 5000 pounds or more are readily discernible, and any lack of fusion at the bottom of the single V is strongly evident.

This method, applied to properly welded tanks, has shown no defects whatever, and on testing one of these tanks to destruction, failure took place out-

side the weld and at no point did it extend into the weld; moreover, the weld was then cut up and no defects were found in the investigation that followed. In testing a small tank purposely made with defective welds unknown to the testers, defects were readily found, and on testing to destruction, failure took place at one of these. Subsequent tensile testing of the weld showed that defects were present at the points indicated by the stethoscope and all other parts of the weld were free from defects.

As applied to structural steel, the same degree of success has been achieved. This method of testing is at once simple, practical, and without harmful effect on the finished product. Tests made up to the present time indicate that it is definitely reliable. It may be considered as qualitative, but it is not precise enough to be quantitative. In the case of structural joints, this is not serious, as it is a very simple matter to melt in and reweld all spots indicated by the stethoscope.

In the case of heavy pressure vessels, it is not considered good practice to reweld without subsequent annealing, due to the setting up of strains, and three possibilities present themselves: (1) to further test the spot non-destructively by other means to determine definitely the extent of the defect; (2) to investigate with a blowpipe, reweld, and anneal; or (3) to condemn the vessel, cut out the weld, and reweld completely. Further testing of the spot may be carried out by means of the X-ray.

Testing Welds by Means of X-rays

That the X-ray has not been used much up to this time for testing welds may be attributed first to expense, and second, to failure of this method in the past to detect lack of fusion along the vee—the most serious type of defect. A satisfactory means of applying the X-ray so as to detect lack of fusion at the vee as well as other defects has been developed at the Union Carbide & Carbon Research Laboratories. The essential feature of this method is that the X-rays shall pass parallel to the scarf rather than normal to the weld. Even with but limited experience with this method of testing, it has been found possible to estimate the strength of welds within 3000 pounds per square inch of the values later found by tensile testing.

The matter of expense involved has become less important, due to the construction of higher voltage types of equipment and the availability of consulting services with the equipment on hand. In vessels up to 2 inches thick, complete examination of the entire weld in a vessel by means of the X-ray is within reason from an economic point of view. The stethoscopic and X-ray examinations are believed to be practical non-destructive tests of welds in pressure vessels. By combining the two, an economical, reliable and quantitatively accurate method of test results. Thus defects would be determined by the stethoscope, and when desirable, these could be quantitatively measured by the X-ray.

Electrical Resistance and Magnetic Testing

Testing welds by means of electrical resistance has received considerable thought, and in the case of a small weld, such as in a rod or strip, this method could be used successfully; however, its application to plates, line welds, structural joints, or other types of welding that are in more general commercial use has not been successful so far as is known.

Magnetic testing seems to offer real possibilities. The magnetic tests investigated have not yet been proved satisfactory when applied to welds and plates. However, other magnetic tests have been evolved, and any of these may eventually prove satisfactory, but there is not sufficient information now available to indicate that such is the case.

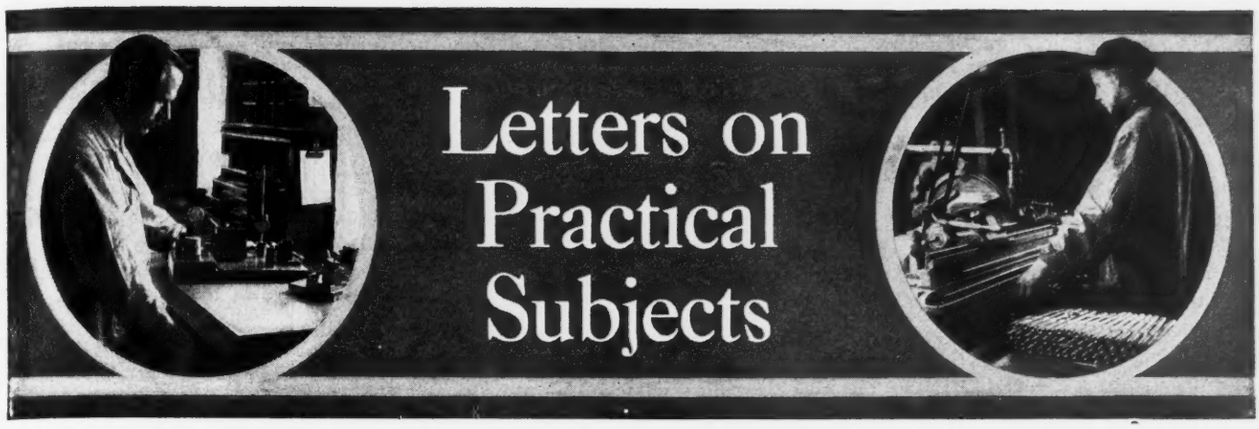
Testing and the Progress of Welding

In the application of both the destructive and the non-destructive tests, well defined engineering procedure is implied, which not only includes testing but also proper designing and welding supervision. This has come to be commonly called "procedure control," and testing is the very basis of this type of control. First the welder must qualify by welding samples, which are then subjected to the tensile test and bend test. Granted the welder qualifies, he is then set to work on the job in question, and at the completion of the weld, the joint is tested. This test may be the hydrostatic test followed by stethoscope testing, X-ray testing, or any other satisfactory non-destructive test or combination of such tests.

Thus there is confidence in the weld, not only because it has been made under procedure control, but also because the non-destructive test shows it definitely to be of good quality. It should be remembered that non-destructive testing is a test of workmanship only, and in no sense a test of the properties of the weld material. The former is determined by the tensile and bend test and the proper application under procedure control. Thus with testing used as it is being used today in the more modern applications, the engineer may be fully confident that the welds in the structure are sound and have the properties that he expects. Lack of confidence as to these matters has seriously retarded the application of welding in the past, particularly where it has been affected by state or engineering society codes. With the increased confidence given by the rational testing under procedure control, we may expect greater recognition of welding in the codes and suitable modification of the codes to meet the advances in the art and science of welding.

* * *

A new high record has been set by the railroads in the speed with which freight traffic is being handled. The average movement per car per day has reached 36.3 miles, which is the highest average ever attained. It is an increase of 2 miles above that of three years ago.



MASTER PLATE FOR SPACING HOLES

Having found it awkward to locate and pierce holes in long lengths of angle-iron by the usual method, the master plate shown in the accompanying illustration was devised to facilitate the work. The piece to be pierced is shown at *A*, and the master plate or templet at *B*. The elongated slots *F* in the master plate locate the work in the proper positions for piercing the holes *G*.

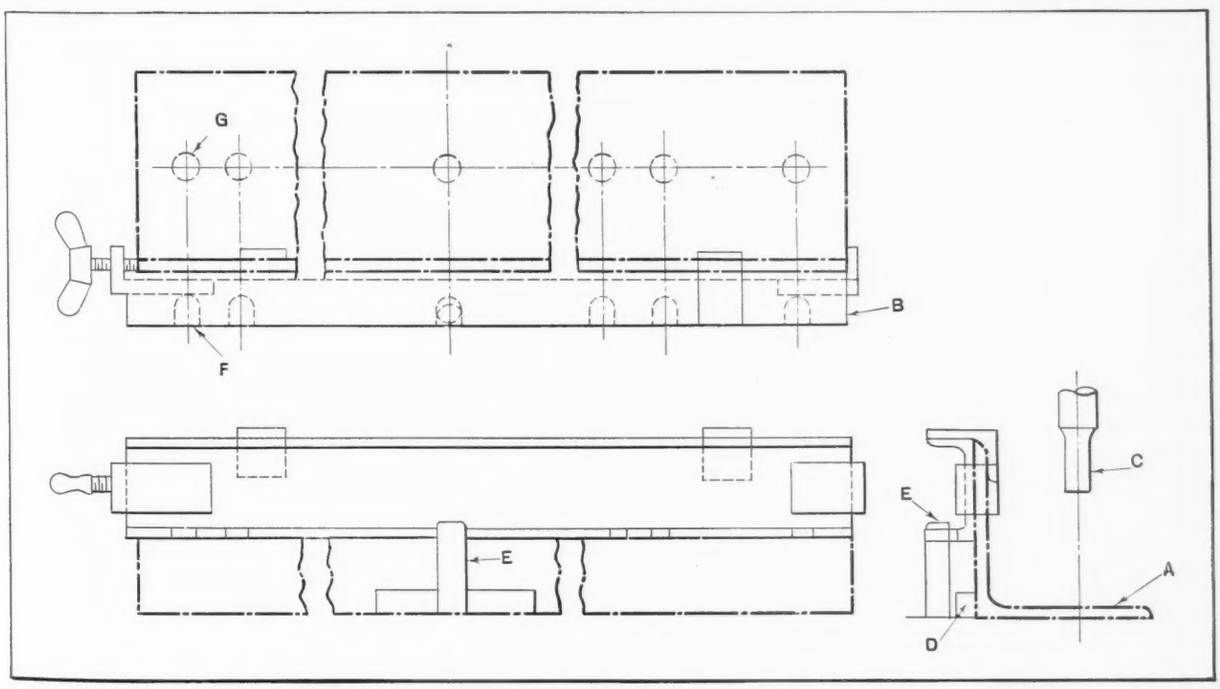
In use, the master plate is slipped over the work and the thumb-screw tightened to hold it in place. The master plate is then placed so that the locating pin *E* in the table is in one of the slots, and the base of the work aligned by the locating block *D*. The position of the piercing punch *C* relative to the work is shown by the end view in the lower right-hand corner of the illustration. The advantage of handling the work in the manner described is that all the locating is done at one point at the center of the press, which can be clearly seen by the operator.

Rockford, Ill. W. E. GUNNERSON

MACHINE FOR SWAGING PIPE TO SIZE

The diameter of butt- and lap-welded steam pipe is held within certain limits that have been established as standard by the manufacturers. For ordinary use, the variation in size within the standard tolerances is not of vital importance so long as the seam is properly welded and the threads are standard. Occasions sometimes arise, however, where greater accuracy is required, both in diameter and roundness. For example, the normal outside diameter of a 3/4-inch standard steam pipe is 1.050 inches. By actual measurement, it will be found to vary from 1.062 to 1.032 inches, a total variation of 0.030 inch. It may also be out of round as much as 0.005 to 0.010 inch.

In the manufacture of a certain product, it is necessary to provide means for bringing great quantities of this pipe to a uniform size. Various methods were tried before a satisfactory solution was found. The first method tried was to force the pipe through a series of shaving dies, varying in diameter by increments of from 0.001 to 0.003



Master Plate Applied to Angle-iron for Locating Pierced Holes

inch. The pipe was propelled by a series of grooved rolls, geared together in pairs. The grooves conformed to the contour of the pipe and were sharply knurled to prevent slipping. When this method was tried out, however, several serious defects were revealed. The knurling on the feed-rolls left the surface of the pipe covered with unsightly pit marks; also, some lengths of pipe would chatter badly as they passed through the dies.

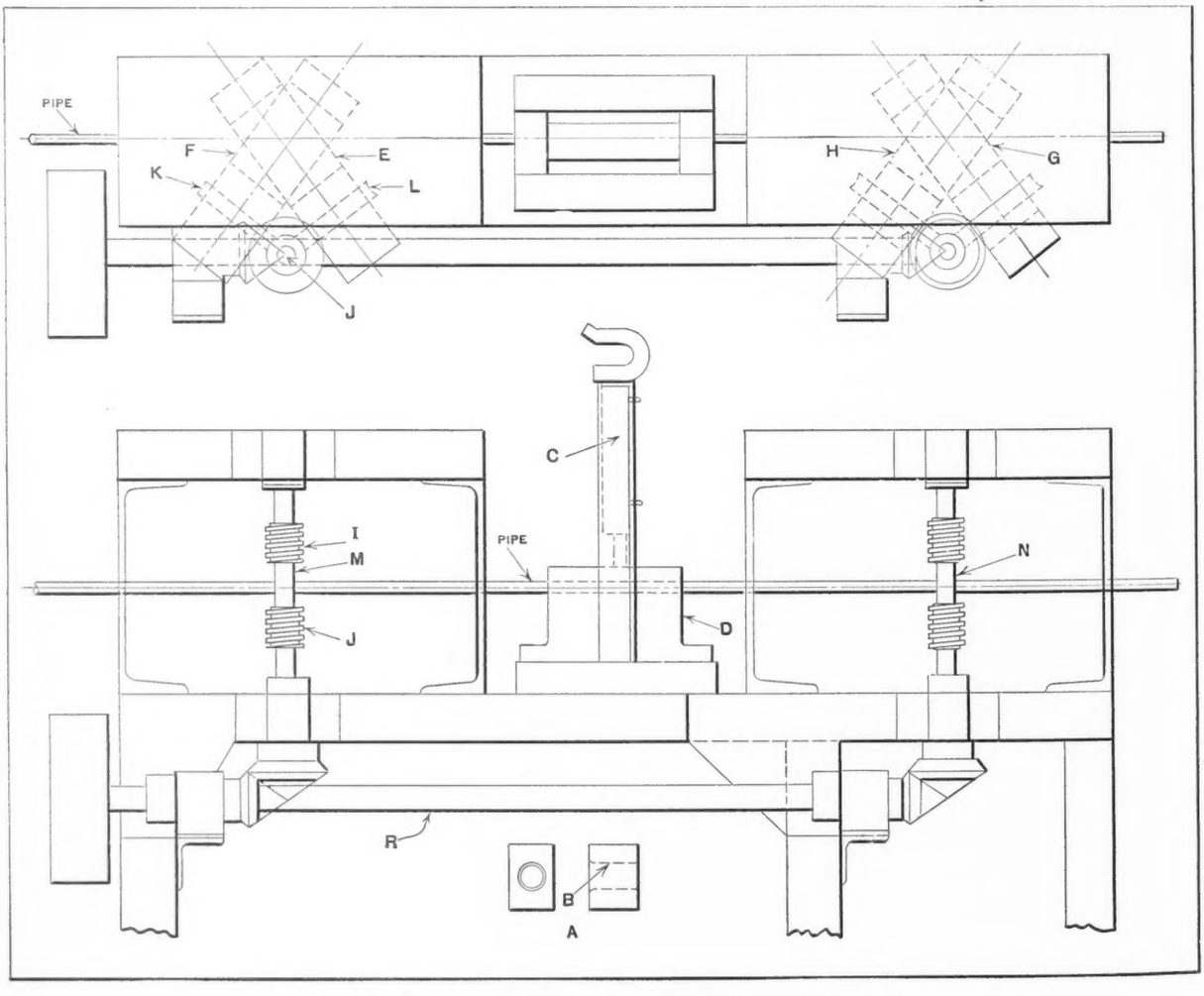
Occasionally, the metal would be torn instead of being cut. This left the surface badly scarred. In the case of some of the larger sizes of pipe, the cutting pressure was so great that the feed-rolls would slip and cut deep "necks" in the pipes. When greater pressure was placed on the feed-rolls, the pipe was flattened, so that too much material was removed from two sides. The pipe was also out of round after passing through the dies.

To overcome these difficulties, it was decided to do away with the feed-rolls and pull the pipe through the dies by a cable anchored at the far end of the pipe. This arrangement proved rather unreliable on account of the stretching of the cable, which caused the pipe to pass through the die with a jerky motion. Finally, a method of swaging was developed which proved satisfactory. Although swaging does not leave a clean bright surface as does the shaving method, it produces a pipe of uniform size and of sufficient accuracy for the purpose intended.

The swaging machine, which is shown diagrammatically in the accompanying illustration, consists of three essential parts—the frame and propelling mechanism; the swaging die; and the hammer. The die, shown at *A* to a larger scale than the rest of the machine, is of hardened tool steel. It is made in halves and ground to the required finish diameter. The two mating faces of the die are ground off very slightly to allow them to close to a size a little below the finish size. The end at which the pipe enters is slightly bell-mouthed at *B* to allow the pipe to start easily.

The hammer *C* is an ordinary pneumatic riveting hammer of a size that will deal heavy blows in rapid succession. It is held in a frame (not shown) directly over the die. The hammer acts against the hardened face of a blank rivet set which rests against the top face of the swaging die. A suitable holder *D* keeps the die in place.

Obviously, the pipe must be fed through the die at a uniform speed while the hammer is operated. Not only must the pipe move longitudinally, but it must also be rotated about its axis in order to obtain uniform reduction and roundness. This com-

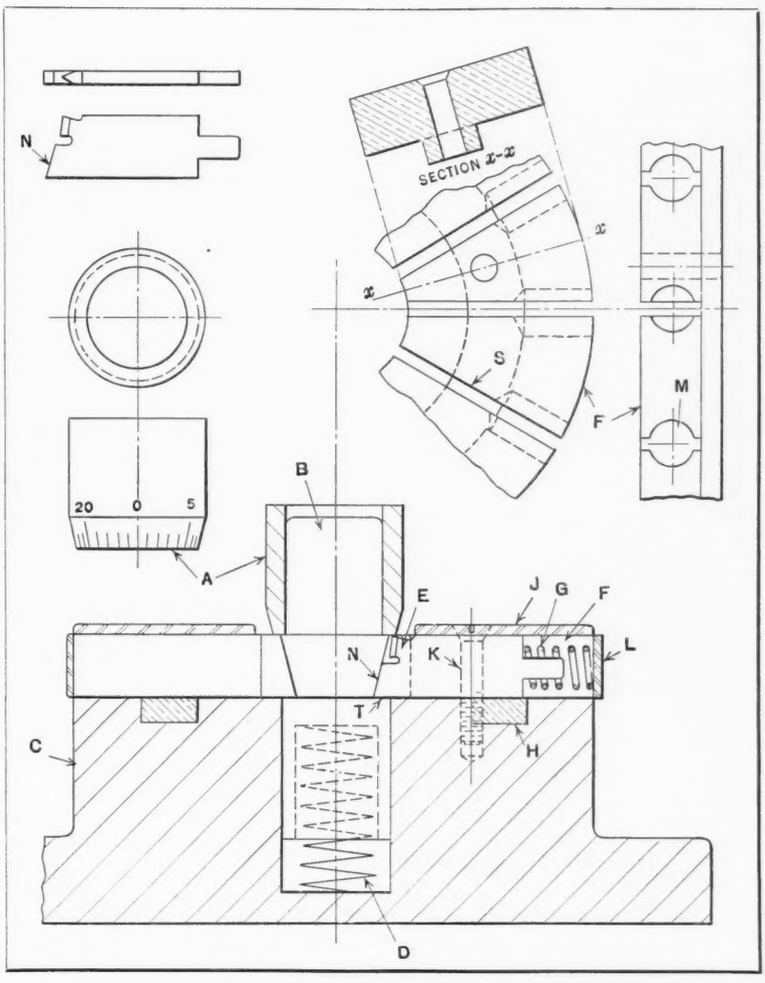


Machine Employed for Swaging Steam Pipe to Uniform Size

bined motion is produced by a pair of rollers *E* and *F* in front of the die and a pair of rollers *G* and *H* at the back of the die. These rollers are set at such an angle that their axes cross each other on the axis of the pipe. Roller *F* is located above the pipe and is driven by a worm *I* mounted on shaft *M*, while roller *E* is located below the pipe and is driven by worm *J*. For clearness, the worm-wheels *K* and *L* secured to the roller shafts are omitted from the lower view. The rollers *G* and *H* at the opposite end of the machine are driven in a similar manner.

The worm-shafts *M* and *N* are driven by bevel gears from the horizontal shaft *R*. The bearings of the lower roller of each set are mounted solid, while the bearings of the upper roller are backed up by a rubber pad which allows a certain amount of movement in order to take care of variations in the pipe diameter. The relative rate of longitudinal and rotative travel of the pipe is governed by the angle at which the rollers are set. The entire frame of the machine is made of structural steel.

St. Louis, Mo. PAUL H. WHITE



Micrometer Sleeve and Die Used in Cutting Graduations

MULTIPLE-CUTTER DIE FOR GRADUATING MICROMETER SLEEVES

The micrometer sleeve of a rifle telescope mount, shown at *A* in the accompanying illustration, is made of duralumin. In the lower part of the illustration is shown the die designed to cut—not stamp—the twenty-five graduations on the tapered end of the micrometer sleeve. Usually the graduations on work of this kind are cut one at a time or produced by stamping or rolling. Stamping or rolling methods do not produce as sharp clean impressions as cutting, and for this reason were not considered suitable for this particular work. Scribing or cutting one line at a time was too slow a process. The multiple-cutter die shown in the illustration not only produced clean-cut lines, but also met production requirements.

The sleeve *A* to be graduated is placed over the centering plug *B*, which is a sliding fit in the cast-iron base *C*. The spring *D* normally holds the centering plug *B* in the position shown. A plan and an elevation view of one of the twenty-five graduating cutters *E* are shown in the upper left-hand corner of the illustration. These cutters slide in radial slots *S* in a brass ring *F*.

The cutters are forced against the tapered portion of plunger *B* and also against the work during the graduating operation by the springs *G*. The ring *F* is located on the base *C* by means of the annular or circular tongue *H*, which fits into a corresponding groove in the base. Incidentally, this tongue serves to hold the sections of the brass ring together after the twenty-five slots for the cutters have been machined.

The cover plate *J*, which holds the cutters in place, is secured by the screws *K* which also serve to hold the ring *F* in position. A metal band *L* is placed around the outside of the brass ring to hold the springs *G* in the drilled pockets *M*.

In operation, the die is set up in either a foot or power press, with a plain round punch mounted in the press ram over the center of the plunger *B*. A blank sleeve to be graduated is placed over the plunger, as shown. As the ram of the press moves down, the punch strikes the top of the work and carries the plunger *B* downward. The inner ends of the cutters have a tapered face *N* which corresponds to a similar taper on plunger *B* and to the taper on the ends of the micrometer sleeve.

Continued downward movement of the plunger forces the cutters outward, so that they cut the graduations to the correct depth. Four out of every five cutters are ground short on their top faces, in order to have every fifth line longer than the four intermediate lines. It will be noted that the cutters are ground with a rake angle on their top faces.

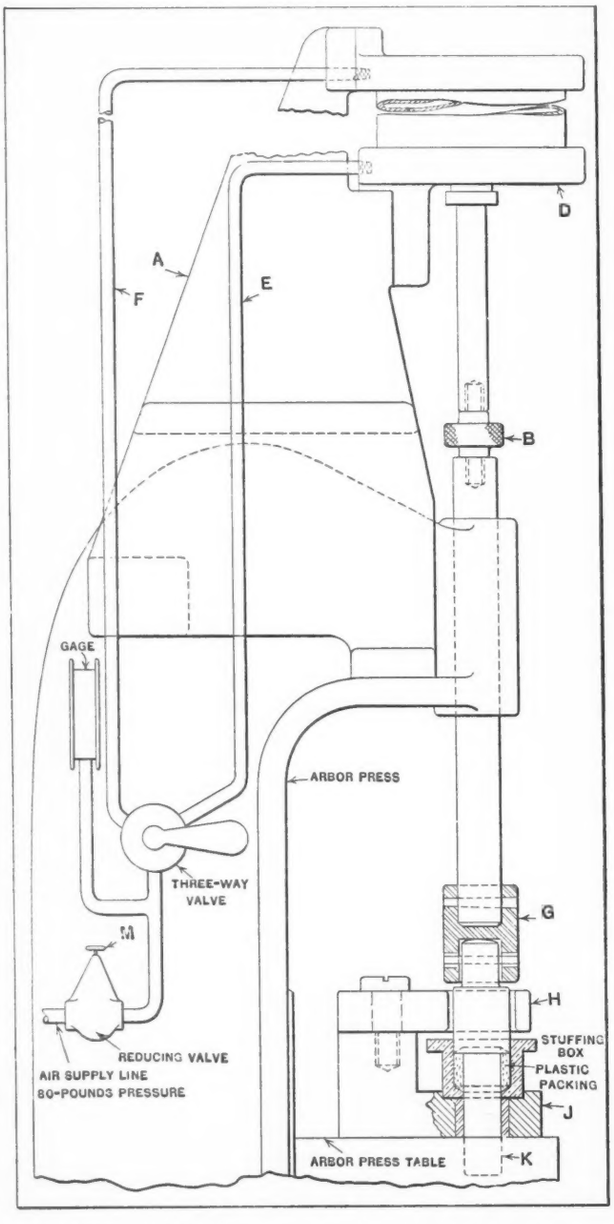
The central plunger is retained by the cutters, the lower surfaces of which come in contact with

the shoulder at *T*. After the work is removed from the die, it is slipped on a taper plug, held in a lathe spindle, and the burrs thrown up at the ends of each cut are removed with a file.

Woonsocket, R. I. DONALD BAKER

PRESSING PACKING INTO STUFFING-BOXES

In order to facilitate production, it is the practice of one pump manufacturer to insert the packing into stuffing-boxes before assembling them in



Air-operated Arbor Press for Forcing Packing into Stuffing-boxes

the pumps. This is done in a regular arbor press equipped with an air cylinder for actuating the ram. The packing used is a plastic material obtained in bulk form, and is forced into the stuffing-box by an arbor attached to the bottom of the ram.

This operation was formerly done in a similar press, but without the aid of the air cylinder equipment. However, the difficulty in judging the required pull on the operating lever resulted in many of the stuffing-boxes being packed too tightly, thus destroying much of the gland adjustment of the packing when finally assembled on the pump shaft.

With the arrangement shown, the same pressure is maintained for the entire lot of stuffing-boxes. The air cylinder *D* is mounted on the bracket *A* fastened to the press, and is equipped with air lines *E* and *F* leading from a three-way valve which can be operated to supply air to either side of the piston. The lower end of the piston-rod is connected to the top of the ram by the double-end knob screw *B* on which are cut right- and left-hand threads. With this arrangement, if it is desired to operate the press with the regular hand-lever, the piston-rod may be quickly disconnected from the ram by removing the knob *B*.

The pressure of the air passing through the three-way valve to the cylinder registers on a dial gage; and by adjusting the handwheel *M* on the reducing valve, any cylinder pressure below the supply line pressure may be obtained. The arbor *K* in the floating holder *G* is a slip fit in the hardened bushing in the fixture *J*. The holder *G* is a slip fit on the end of the ram to which it is secured by a taper pin.

In operation, air is admitted to the under side of the piston to raise the arbor *K* high enough to allow the stuffing-box to be located in the fixture. Air is then admitted to the top of the piston until the lower end of the arbor has passed through the small hole in the stuffing-box. With the arbor in this position, and with the open-side strap *H* swung back out of the way, the plastic packing is evenly distributed by hand in the stuffing-box. Air is then admitted to the top of the cylinder again, and as the ram descends, the angular shoulder on the arbor compresses the packing the required amount. The strap *H* is then swung into the position shown, so that it will strip the packing from the arbor as the ram rises.

Glen Ridge, N. J. J. E. FENNO

BABBITTING LARGE BEARINGS

It is common practice in babbitting a bearing to pour the babbitt in the space between the bearing shell and the mandrel. This method is satisfactory for bearings having a diameter up to 12 inches. In babbitting larger bearings, however, blow-holes and gas pockets are likely to be formed, which may not be detected until the bearing is machined. These blow-holes and gas pockets are caused by the imprisonment of gas bubbles and air in the metal during solidification.

The more the metal is agitated in the mold, the greater is the number of blow-holes produced. In babbitting small bearings, the metal is poured from a relatively low height, and there is, consequently, very little agitation of the molten babbitt. In babbitting larger bearings, the babbitt is, of course, poured from a greater height, and the splashing

and agitation of the babbitt is naturally much greater, resulting in the formation of a considerable number of blow-holes and air pockets.

When the babbitt lining has been turned down to the required thickness, the blow-holes are filled in with babbitt metal by the use of a hot soldering iron. The excess metal is then removed by machining. It is obvious that considerable time and labor must be spent if there are many blow-holes, and the writer knows of cases where three days have been required to produce a satisfactory babbitt lining for a large bearing.

It has been found that by bottom-pouring the babbitt, that is, pouring the metal through a tunnel or lead which enters the mold at the bottom, only a few, if any, blow-holes and air pockets are formed, even when babbitting very large bearings. The babbitt rises when this method of pouring from the bottom upward is used, forcing the air and gases ahead of it, so that a solid lining is formed. The agitation and splashing of the metal is naturally much less than when the metal is poured in the old way. Since the babbitt shrinks on passing from the liquid to the solid state, it is good practice to put a layer of clay or other suitable material on top of the shell, so that the height is increased from 1/2 to 1 inch. By filling the mold nearly to the top of the clay wall, allowance is made for shrinking.

Since the babbitt metal solidifies in the tunnel, the separation of the mandrel is not so easily accomplished as when using the ordinary method of babbitting. This disadvantage is, however, insignificant in comparison with the saving of time and labor and the better lining obtained.

The method described is being employed by some of the largest users of babbitt metal in this country. It is really surprising that this method has not been used more extensively, as it has been known for a good many years that bottom-poured metal ingots are superior to those poured from the top, having fewer blow-holes and other defects.

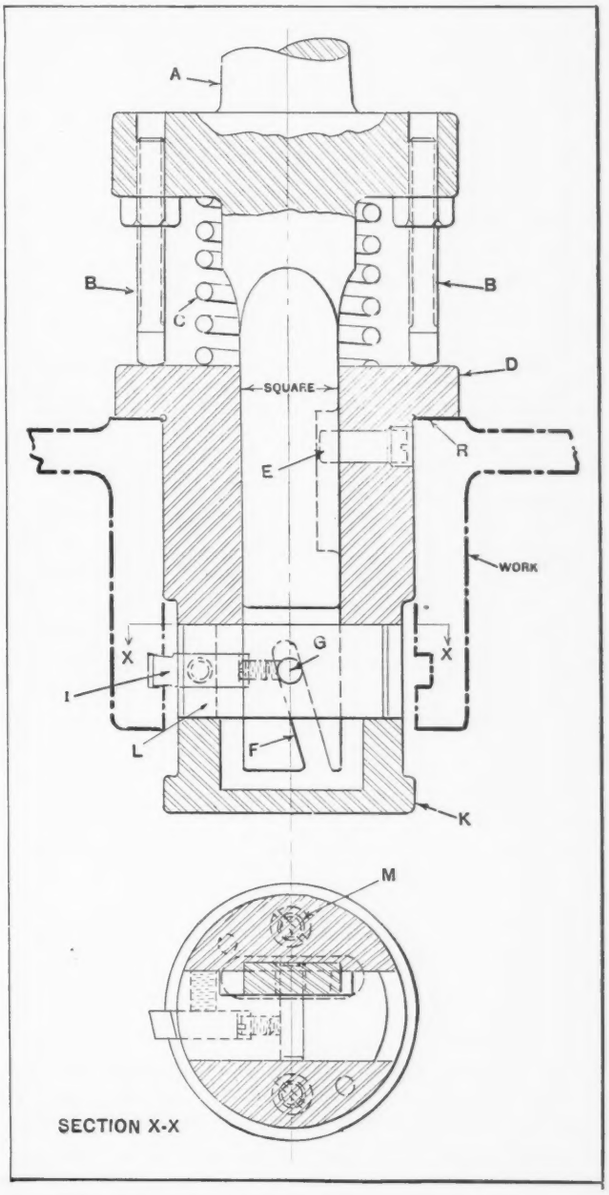
Chicago, Ill. JAMES SILBERSTEIN

RECESSING TOOL FOR USE ON DRILLING MACHINE

The recessing tool shown in the accompanying illustration is used on an upright drilling machine for cutting an annular groove in a casting of such shape and size that it could not be handled on a lathe or boring machine. In operation, the revolving tool is guided into the hole to be recessed by the pilot *K* of the bushing *D*. When the flange of bushing *D* comes in contact with the finished face *R* of the boss on the work, shown by heavy dot-and-dash lines, the downward motion of bushing *D* ceases.

The continued downward feeding movement of the machine spindle causes the cam at *F* in part *A* to force the tool or cutter *I* outward through its action on the pin *G*. Pin *G* is fixed in the slide *L* in which the tool *I* is held. The outward feeding movement of the tool continues until the set-screws *B* come in contact with the head of bushing *D* as shown in the illustration. When the machine spindle is raised, the tool *I* is withdrawn until it clears the work, after which the continued upward movement withdraws the bushing *D* from the hole in the casting.

The hardened die bushing *D* is a slip fit in the bored hole in the work. In the center of this bushing is a broached square hole which receives the lower end of member *A*, the upper end of which has a taper shank which fits the machine spindle.



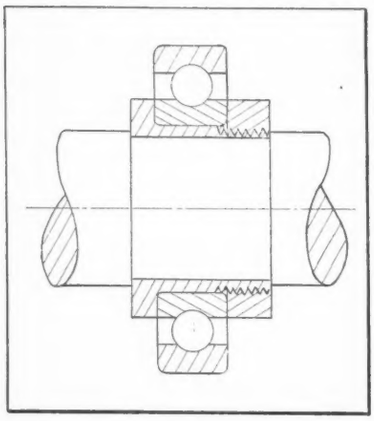
Tool for Cutting an Annular Groove in a Casting

The pilot end or cap *K*, which serves to retain the slide *L*, is held in place by two fillister-head machine screws *M*. The screw-head pin *E* enters the elongated slot in part *A* and prevents bushing *D* from sliding off the square shank when the tool is raised. The spring *C* serves to hold the bushing *D* down on the work until the grooving tool has been fed in to the required depth and withdrawn.

Fairfield, Conn. F. E. JUDSON

MOUNTING FOR BALL BEARINGS

The usual practice, in mounting ball bearings on a shaft, is to clamp the inner race against the shoulder by means of a nut. This can be easily accomplished when the bearing is located at the end of a shaft. When a bearing is to be mounted at the center of a long shaft, however, it is not such a simple matter. The turning and threading operations weaken the shaft and often necessitate the introduction of undesirable or awkward changes in the design of other parts. The mounting shown in the accompanying illustration was designed to avoid these difficulties.



Ball Bearing Mounted on Necked Shaft

In the mounting illustrated, the bearing and nut are slipped on over the end of the shaft. The shouldered collar is machined to the required diameters and then parted, after which the two halves are placed over the shaft and the bearing assembled. The shallow neck turned in the shaft insures correct lateral position, but weakens the shaft and may be otherwise objectionable. However, the bearing may be mounted without necking the shaft by turning the shouldered collar so that a press fit exists between the collar and the shaft and between the collar and the bearing when the mounting is assembled.

Rochester, N. Y. ERNEST C. ALLEN

CLEANING BEARING SHELLS PREPARATORY TO RELINING

In order to obtain satisfactory results in remetalling or relining bearings having either bronze, brass, steel, or cast-iron shells, it is necessary that the surface to be relined be absolutely clean. A very effective method of removing all grease and dirt from the shells is to scour them with a paste made from pumice powder and turpentine. Just enough pumice powder should be added to the turpentine to make a very thin paste.

When the bearing shells are not dovetailed, difficulty is sometimes experienced in getting the white metal to adhere to the shell with sufficient firmness. In such cases, there is danger of the lining metal parting from the shell. This can be prevented by sponging the bearing surface with a solution of copper sulphate (blue vitriol crystals), adding about 1/4 pound of crystals to one gallon of water. When dry, the metal surface should be lightly wiped with a soft cloth. This treatment will etch the surface slightly. The white metal will adhere more readily to this rough surface, and any possibility of loosening will be prevented. When the shells are to be tinned, they should be treated in the same manner before tinning. The treatment can also be repeated after tinning if it appears to be necessary. Both tin and white metal will adhere more readily to a rough surface than to a smooth one.

Brighton, England W. E. WARNER

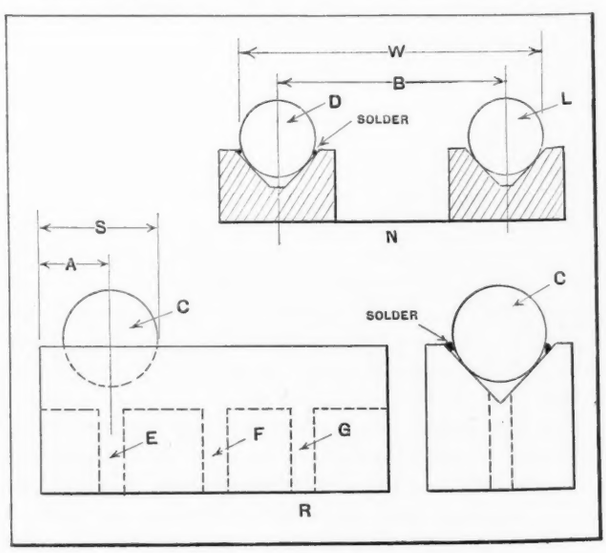
USING STEEL BALLS IN TOOL-ROOM WORK

The writer has found that steel balls can be used to advantage in tool-room work for such operations as drilling accurately spaced holes in V-blocks. For example, the V-block shown at *R* in the accompanying illustration, which was part of a drill jig, was required to have three accurately located holes *E*, *F*, and *G*. Each of these holes had to be a given distance from the end of the V-block and in the center of the V-slot. The tolerance on this work was specified as 0.001 inch.

The method of obtaining the required accuracy was to place a 1-inch steel ball *C* in the V-groove, locating it in the proper position over the center for hole *E* by measuring the distance *S* with a height gage. The ball thus located was secured in place by solder, as indicated in the end view. The V-block was then clamped on the faceplate of a lathe, and an indicator used to align ball *C* with the center of the lathe spindle, after which the ball was removed and the hole bored to size. The same procedure was followed in boring the holes at *F* and *G*.

At *N* is shown a cross-section of a plate having two parallel V-grooves. In this case, it was required to check the distance *B* between the centers of the grooves. To do this, a 1-inch steel ball *D* was soldered in one of the grooves, and another ball *L* placed in the other groove. Then the distance *W* was measured with a micrometer, and the diameter of the ball subtracted from the measurement to obtain the distance *B*.

Philadelphia, Pa. CHARLES KUGLER



Applications of Steel Balls to Tool-room Work

New Air Grinder for Use in Diemaking

Spindle Speeds in Excess of Forty Thousand Revolutions Per Minute Obtainable for Grinding Wheels of Very Small Sizes

THE Madison-Kipp Corporation, Madison, Wis., maintain a tool-room which is engaged in making die-casting dies both for use in the production of their own lubricator parts and for manufacturers to whom they have sold die-casting machines. This work brought out the need for a tool capable of finishing irregularly curved surfaces in die-castings rapidly and also for touching up such surfaces to correct any distortion produced in hardening. The latter requirement naturally narrowed the quest to the grinder class. As a result, work was started on the design of a special grinder, and after two years spent in its development, the Kipp air grinder illustrated in Fig. 1 was produced.

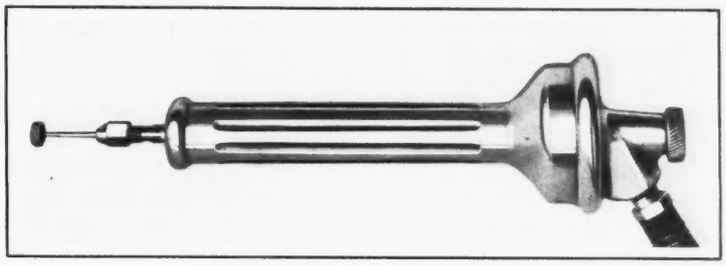


Fig. 1. Kipp Air Grinder which Runs at Speeds in Excess of Forty Thousand Revolutions Per Minute

A wide range of grinding wheels can be used on this grinder. They may be of various forms to suit irregular surfaces, but a wheel only a fraction of an inch in size can be driven at sufficiently high speeds for efficient operation. Different forms of polishing wheels may also be employed in cases where ground surfaces are not smooth enough. This air grinder proved so successful in the Madison-Kipp tool-room that the decision has been made to manufacture it for the market. It is intended for use in making dies for die-castings, drop-forgings, metal stampings, bakelite, and other molded parts. Other applications may be found in making metal patterns and in removing fins and flashes from small forgings, die-castings, and similar parts.

This air grinder is held and used somewhat the same as a fountain pen. The over-all length is 8 1/4 inches and the diameter of the barrel a little thicker than a man's finger. The weight is 12 ounces. In the upper end of the housing, there is a turbine wheel on the spindle for driving it. One-fourth turn of the knurled knob at the same end of the housing opens or closes the port that admits compressed air to the turbine.

This air is distributed through four equally spaced ports and then passes through inclined nozzles and against the closely spaced teeth of the turbine wheel. The close spacing of these teeth is one of the factors that insures smooth and quiet running of the grinder under the high rotative speeds necessary to drive the small sized wheels at surface speeds in excess of 5000 feet per minute. After escaping from the turbine wheel, the air passes down the barrel of the grinder and through exhaust ports at the lower end, blowing away the grindings and abrasive dust which would otherwise tend to accumulate in the cavity being ground.

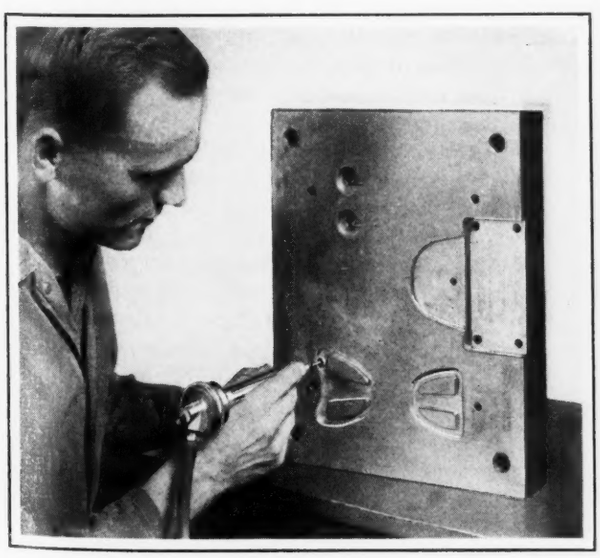


Fig. 2. Finishing an Irregular Cavity in a Die with the Air Grinder

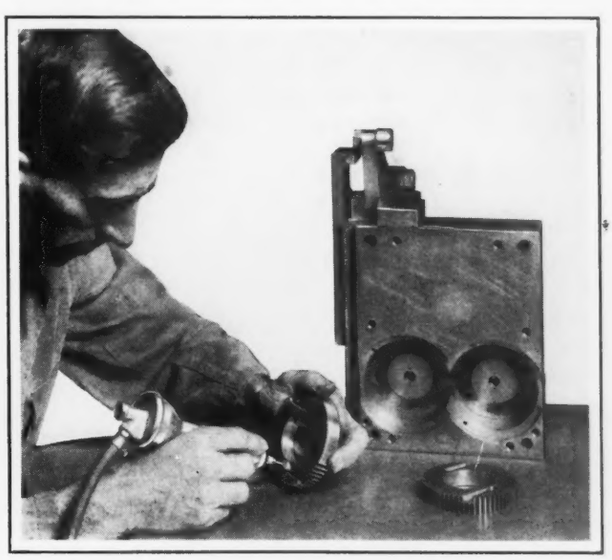


Fig. 3. Correcting a Slight Error in the Throw of Cam Grooves in a Gear

Fig. 4. Grinding a Special Contour on an End-mill

Fig. 5. Sharpening a Forming Tool Used in Die Work

To carry a spindle rotating in excess of 40,000 revolutions per minute satisfactorily, special care had to be given to the bearings. At the upper end, the spindle is mounted in a ball bearing provided with seals that retain a sufficient supply of lubricant to last for six months of operation. The lower end of the spindle is mounted in a bronze bushing. An axial hole drilled in the spindle is fitted with a wick that holds sufficient lubricant for one hour of operation. Centrifugal force throws this lubricant out from the wick through a cross-hole in the spindle leading to the bearing.

The examples shown in Figs. 2 to 5, inclusive, give an idea of the flexibility of the grinder. In a die-casting die recently made, cores were advanced and withdrawn by two cam grooves in a gear. These grooves had to be so located in relation to the ground central bearing that they would give the throw exactly. After the piece was hardened, it was found that the grooves failed to withdraw the cores far enough to make the die operative. The error was slight—approximately 0.020 inch—but it was there.

Without the grinder it would have been necessary to anneal the piece and correct the error by milling, but distortion produced in the rehardening might have introduced a new error just as serious as the first. With the grinder, fifteen minutes sufficed to touch up the cam grooves and to overcome a trouble that might have required the making of a new piece, involving two days work.

Another time-saving application is in grinding such tools as end-mills, reamers, etc., for certain purposes. If, for example, it is necessary to obtain a radius at the bottom of a blind hole, an end-mill may be readily touched up to the desired contour without impairing the sharp cutting edge.

Another application is in finishing the curve of forming tools for use in lathes or on shapers. An important consideration in grinding such tools is the fact that the sharpening may be accomplished without disturbing the setting of the tool or the work. In grinding forming tools having a circular cutting edge, time may be saved by using a grinding wheel dressed to the same radius.

* * *

MARKING AGE AND COST ON MACHINES

The accompanying illustration shows a plate that is fastened to every machine tool in the plant of the Monarch Machine Tool Co., Sidney, Ohio. This plate contains the following information: Factory number, manufacturer's serial number, date when installed, and cost of machine in dollars.

"In this way," says W. E. Whipp, secretary and treasurer of the company, "we have constantly staring us in the face the exact age and cost of every piece of equipment in our plant. We are quite proud to show these plates to our visitors, because they indicate that we take our own medicine and propose to use nothing but the latest developments in machine tool equipment. Many visitors have asked us for samples of these plates, stating that they propose to adopt this system immediately.

"Superintendents of shops who have put these plates on their own equipment tell us that some of the dates ran back from thirty to forty, and even forty-five, years. This has proved to be an effective method of convincing the chief executives that economical operation is being prevented by the use of obsolete equipment.

"It also has a mighty good effect on the operators to have the actual cost of each tool shown right on the tool itself, because it makes them realize how much the company has invested in the equipment they handle and use."

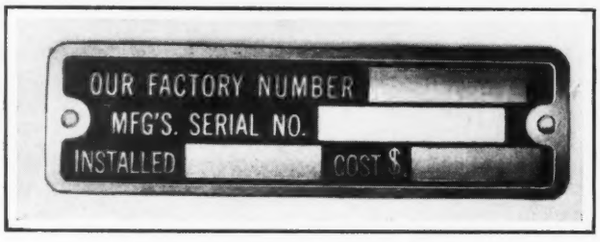


Plate Fastened to Every Machine in an Ohio Machine Tool Shop

Designing Multiple-Spindle Drilling Heads

The Application of Data Sheets to the Solution of Problems Involved in Designing Drilling Heads Equipped with Drills of Various Sizes

By ALFRED M. WASBAUER, Standardization Engineer
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IT is comparatively easy to design a multiple-spindle drilling head which is to use the same size drill in each spindle. When the head is to be equipped with drills of various sizes, the problem becomes more complicated, especially if there is considerable difference in the sizes of the drills and it is important that the best possible results be obtained.

Data Sheets Nos. 171 and 172, on page 480-A of this number of MACHINERY, and the chart accompanying this article (see page 476) were prepared with a view to simplifying the designing of multiple-spindle heads. The chart and the Data Sheets have been tested in actual practice for a considerable period of time, and have been found dependable.

The accompanying chart has a scale showing the number of cubic inches of metal removed per minute by drills ranging from 1/8 to 1 3/8 inches in diameter operated at feeds of from 1 to 12 inches per minute. The horsepower consumed in drilling any one of four different materials commonly used in the automotive field—namely, steel, aluminum, cast iron, and semi-steel—can also be quickly determined from this chart. The heavy dotted lines *A* and *B* indicate how the example given at the top of the chart is solved. Of course, the chart can also be used inversely to find the rate of feed per minute required to remove a given volume of metal.

The Data Sheets on page 480-A will greatly facilitate the rapid planning of multiple-spindle drilling heads using drills of different diameters which must all feed at the same rate. With multiple-spindle heads of this kind, it is obvious that all the drills cannot operate at their most efficient cutting speeds. The large drills must have a rather high cutting speed to avoid taking too large a chip, whereas the cutting speed of the small drills is likely to be too slow. These factors were taken into consideration in determining the cutting speeds given in the Data Sheets.

The horsepower required, as given in the Data Sheets, was derived from tests made with new "Cleforge" drills. In the case of aluminum, if the nature of the work permits a higher rate of feed than 8 inches per minute, a proportionately higher cutting speed may be used. A higher cutting speed without a proportional increase in the rate of feed would be disadvantageous, as the drill would take too light a chip and would only be subjected to unnecessary wear as a result of the scraping action.

The Macrome Process for Increasing the Endurance of Tools

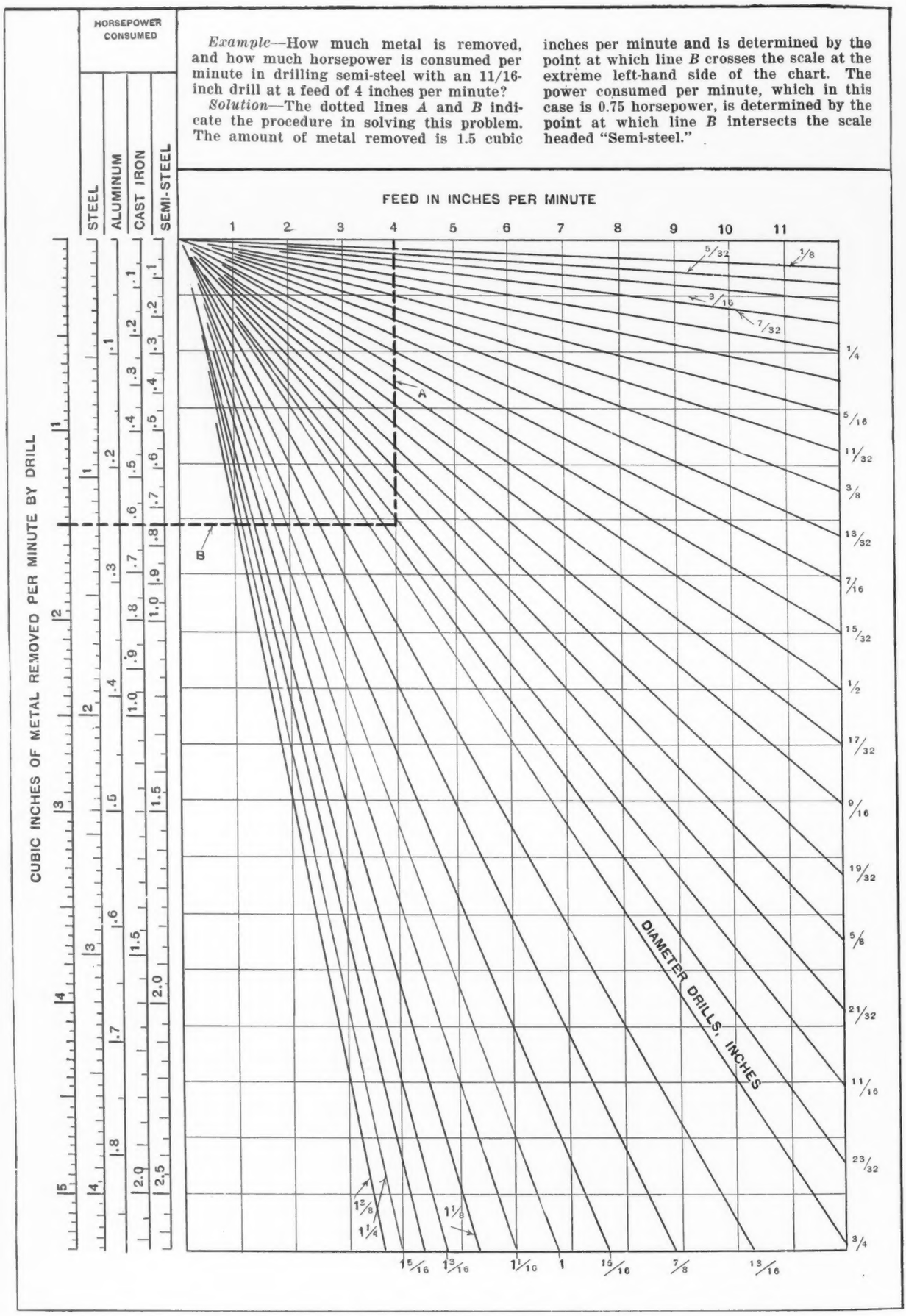
A process that is claimed to increase greatly the endurance of tool steel under normal cutting conditions was recently described in *Engineering*. It has been developed by Grist & Co., Birmingham, England, and is known as the Macrome process. The treatment is applied to the finished tool. It is stated to leave the chemical composition of the steel unaltered, and, owing to the fact that it is carried out at low temperatures, to bring about no change in the size or shape of the tool. The effect is said to permeate the whole mass of the steel treated, and to be permanent. Grinding does not affect the treated tool; should the latter, however, be reheated or forged, the process must, of necessity, be repeated. It is claimed that the results obtained are due to the fact that the process enables the steel to resist vibration for a longer period, and so retards the breakdown of the structure.

While this has not been definitely proved, there appears to be little doubt that the treatment is effective in prolonging the life of tools and thereby materially decreasing costs of production, as tests carried out by engineering firms in various parts of England have shown. In one case, a 14 per cent tungsten high-speed steel milling cutter, working at a speed of 60 revolutions per minute, the feed being 3 inches per minute, and the depth of cut 0.45 inch, gave, as originally heat-treated, a length of cut of 136 inches before regrinding became necessary. After being subjected to the Macrome treatment, the tool, working at the increased speed and feed of 76 revolutions per minute, and 3 3/4 inches per minute, the depth of cut remaining 0.45 inch, gave a length of cut of 768 inches. Even at this stage, the cutter is stated not to have required regrinding. In another instance a firm employing only treated drills for a trial period of one month, found, at the end of the month, that only fifteen dozen drills, instead of the customary twenty-eight dozen untreated drills, had been used.

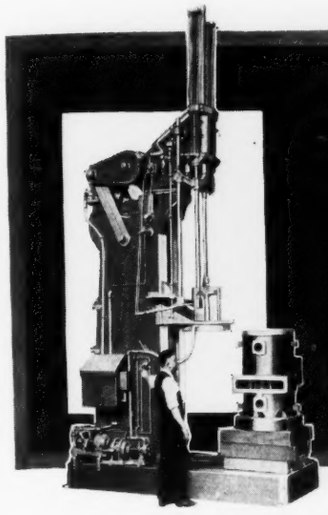
These results appear to be of sufficient interest to justify mention, but, up till the present, no technical particulars regarding the nature of the process have been made available for publication. The process is stated to be applicable to small tools of both carbon and high-speed steel.

Example—How much metal is removed, and how much horsepower is consumed per minute in drilling semi-steel with an 11/16-inch drill at a feed of 4 inches per minute?

Solution—The dotted lines *A* and *B* indicate the procedure in solving this problem. The amount of metal removed is 1.5 cubic inches per minute and is determined by the point at which line *B* crosses the scale at the extreme left-hand side of the chart. The power consumed per minute, which in this case is 0.75 horsepower, is determined by the point at which line *B* intersects the scale headed "Semi-steel."

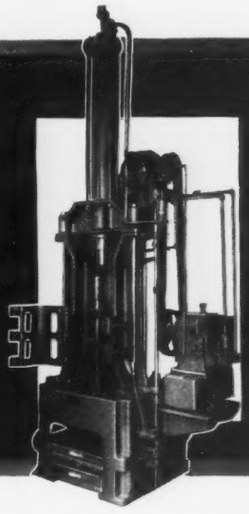


Cubic Inches of Metal Removed and Equivalent Horsepower Consumed in Drilling



New Shop Equipment

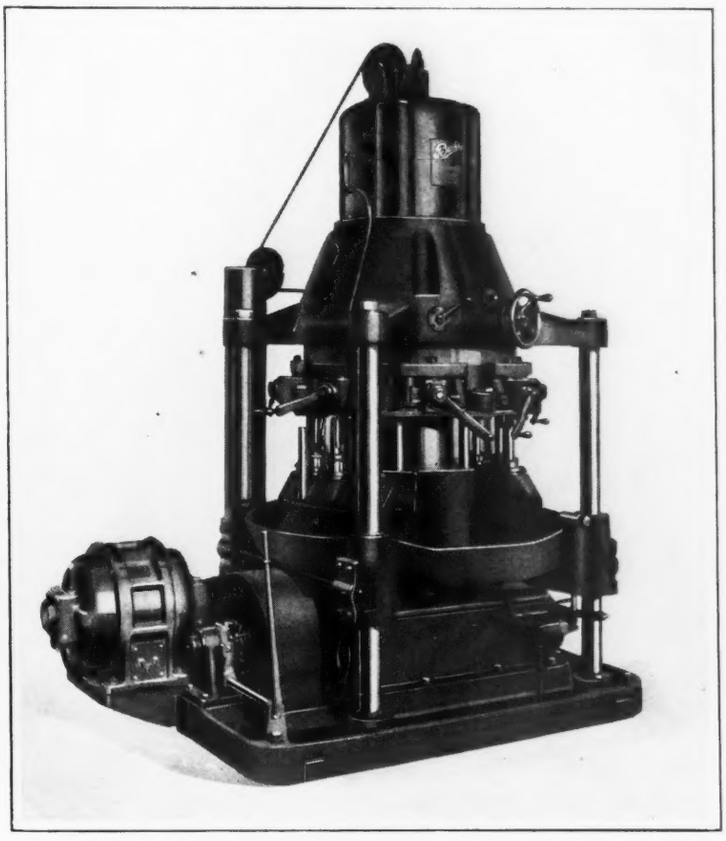
A Record of the Latest Developments in Metal-working Machinery, Small Tools, and Work-handling Appliances



BUHR INVERTED-TYPE MULTI-HEAD DRILLING AND BORING MACHINE

Freedom of chips around the cutting tools is the main advantage claimed for an inverted type of multiple-head drilling and boring machine recently developed by the Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich. In this machine, the work-holding indexing fixture is located in the top above the tools. The construction is well adapted to the use of pilots on the cutting tools because the pilots are above the work where chips or grit do not get on them. Every tool is easily accessible.

The particular machine shown is equipped with a four-position indexing fixture that is designed to hold sixteen pieces of work, four in each position. The first or front position of the machine is used for loading and unloading; the second position, for rough-boring a hole 1 3/4 inches in diameter by 3 3/4 inches deep in each of the four pieces; the third position, for finish-boring the same holes; and the fourth position, for reaming them. The time per cycle is 44 seconds.



Buhr "Super" Production Drilling and Boring Machine in which the Cutters are Below the Work

While the machine is best suited for either drilling or boring long holes, other operations such as counterboring, hollow-milling, and facing can be performed to advantage. The machine may be operated either automatically or semi-automatically through a push-button located to the right of the operator. Each cycle consists of a rapid approach to the work, a feed at a predetermined rate, and, finally, a rapid return to the starting position. The feed may be stopped at any point by depressing a foot-pedal. Pick-off gears provide for different rates of feed. A safety clutch built into the feed-shaft has an adjustment means for controlling the maximum load allowed on the tools. Any load in excess of that for which the machine is set will cause the feed to stop automatically. The weight, without fixtures, is 20,000 pounds.

SCHRANER CRANKCASE BROACHING MACHINE

A vertical type of broaching machine equipped with an Oilgear hydraulic feed and designed for broaching the main-bearing cap seats in automobile crankcases is shown in the accompanying illustration. This machine is a recent development of A. P. Schraner & Co., Payne Ave., and E. 33rd St., Cleveland, Ohio. After the operator has loaded a crankcase in the machine, as shown, and clamped it in place, he starts the operation by moving the hand-lever. Hydraulic pressure then forces the broach through the work.

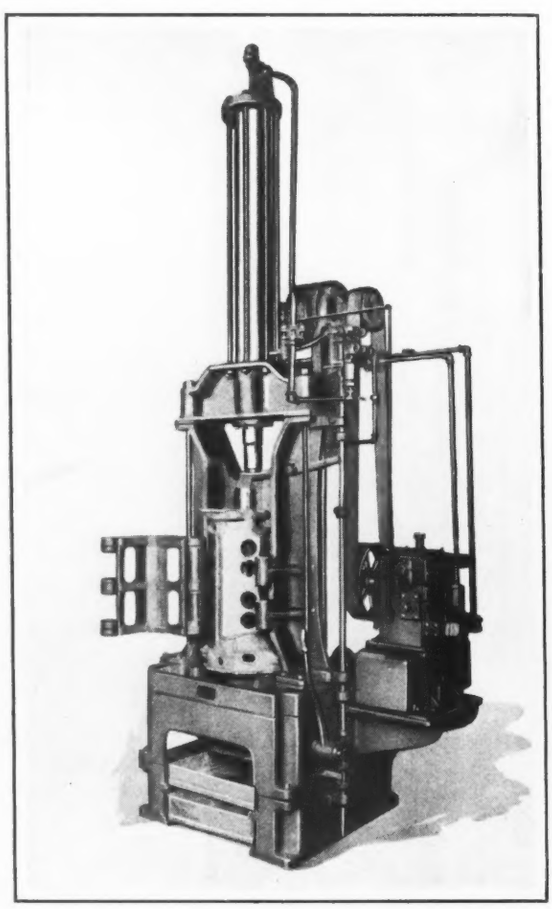
At the end of the operation, the machine stops automatically. Then the operator unloads the crankcase, and by means of the hand-lever, returns the broach to the upper position, ready for the next piece. It is intended that the crankcase come to this machine rough-milled with from 0.015 to 0.020 inch of stock left for broaching. Speed of operation, freedom from cutter marks, and a large amount of work per grind of the tool are the principal advantages claimed for this machine.

This machine is also built in a horizontal style. It may be used for broaching either aluminum or cast-iron crankcases.

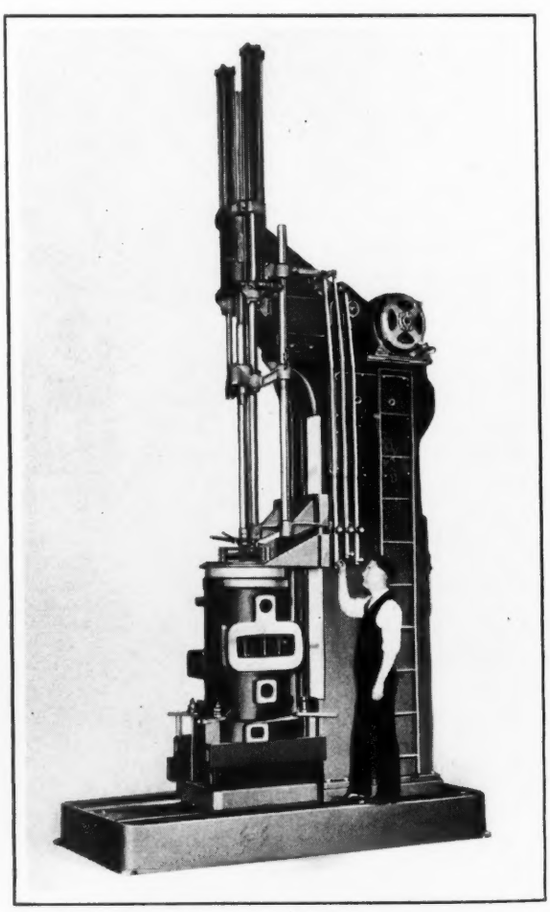
BARNES DRILL CO.'S HONING MACHINE FOR LARGE CYLINDERS

Cylinders up to 20 inches in diameter by 54 inches in length can be honed in a vertical type of machine recently developed by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill. This honing machine has a hydraulic reciprocated spindle and is intended for honing the cylinders of Diesel, steam, oil, and gas engines, as well as air and hydraulic cylinders and other cylinders of large diameter or unusual length. The machine has a swing of 36 inches and a maximum stroke of 56 inches. Other lengths of stroke and shorter or longer columns than the one on the machine illustrated may be supplied. The spindle and hone assembly are balanced by a patented air counterbalance.

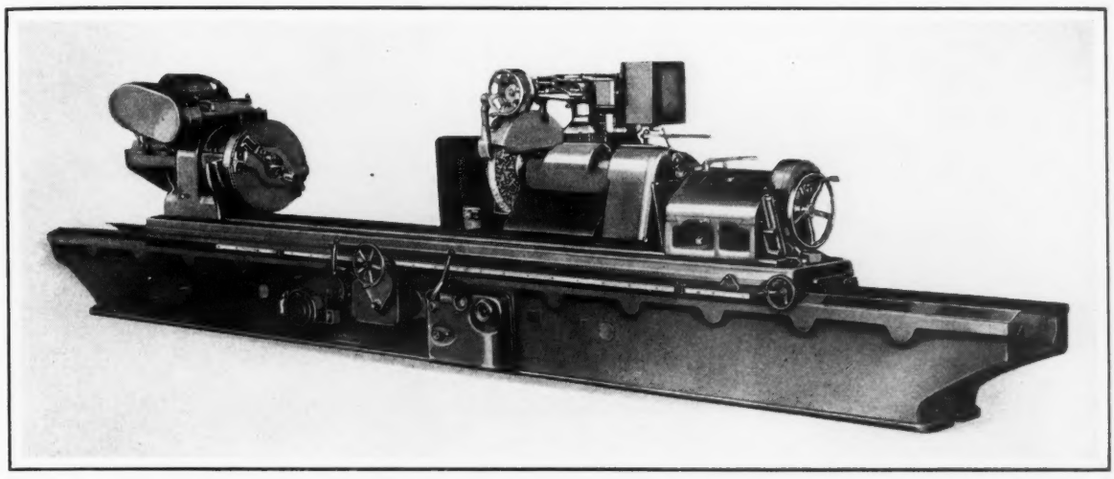
The work-carrying table is moved in and out on the bed by means of an air cylinder, to provide for conveniently loading and unloading heavy cylinders. The table rolls on ball bearings. The 3-inch diameter spindle has ten splines and is reciprocated by duplex hydraulic cylinders. Eight quick-change spindle speeds are



Schraner Hydraulic Crankcase Broaching Machine



Barnes Drill Co.'s Honing Machine



Landis Hydraulic Grinding Machine Built in Four Swings for Rolls up to 28 Inches in Diameter

furnished. The machine is fully equipped with radial ball bearings and Timken tapered roller bearings, the spindle rotating in Timken bearings. The machine is self-oiling.

The hydraulic mechanism includes an Oilgear pump with a special three-in-one valve control. The cycles of reciprocation may be changed to suit the job by means of a volume regulator control on the pump. The length of stroke may be set for just the right amount of over-run of the hone at each end of the cylinder. This feature is important in preventing bell-mouths, barrel shapes, and tapers. Large cylinders reamed to within 0.005 to 0.008 inch of size may be honed to size within an accuracy of 0.001 inch on this machine. The long honing stones pass over port-holes or recesses, leaving true edges around such openings.

A combined control lever is provided for the multiple-disk driving clutch, and this lever simultaneously starts the reciprocations. A latch on the lever permits of reciprocating the spindle without rotating it, or vice versa. Some of the principal specifications of the machine are as follows: Height of regular machine with the spindle up, 18 feet 8 inches; standard distance from the center of the spindle to the face of the column, 18 inches; maximum distance from top of table to nose of spindle having a No. 5 Morse taper, 10 feet 6 inches; working surface of air-operated work-table, 30 by 30 inches; horizontal travel of table, 30 inches; and weight, approximately 12,000 pounds.

LANDIS HYDRAULIC ROLL GRINDER

A Type B hydraulic roll grinder designed for grinding the smaller diameter rolls, either straight, concave, or convex, has been brought out by the Landis Tool Co., Waynesboro, Pa. It is built in 16-, 20-, 24-, and 28-inch swings and in any length between 8 and 16 feet in increments of 2 feet. The 20-inch swing machine is especially recommended by the builder for the strip steel industry.

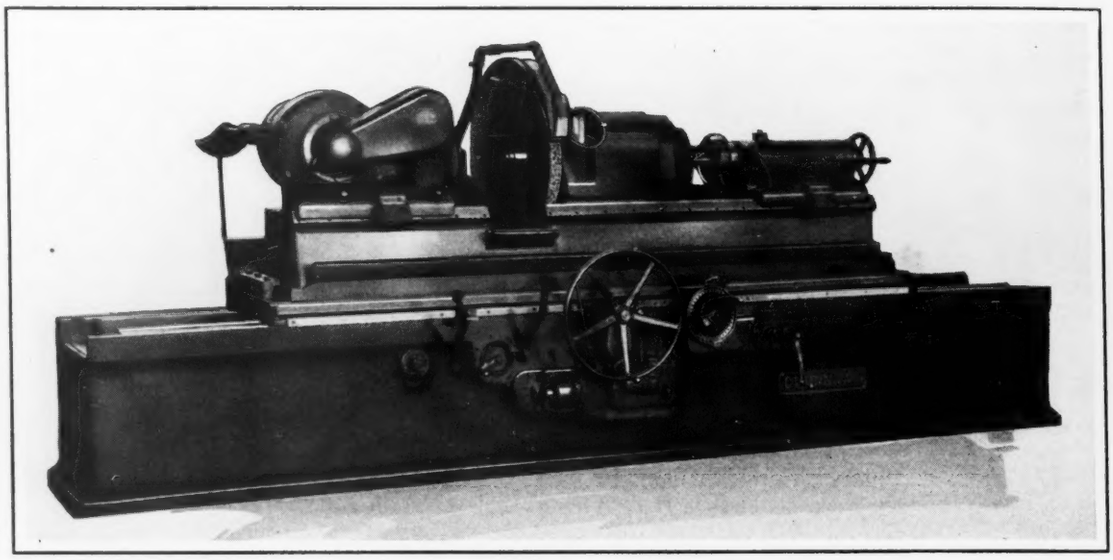
The main features of this machine include a hydraulic work-carriage traversal and reversal which gives an almost unlimited number of speeds with smoothness and quietness; an end drive to the grinding-wheel spindle through multiple V-belts; a 30-inch diameter grinding wheel; and an accurate crowning and concaving mechanism of wide range and simplicity of operation.

The work-carriage traverses on a vee and flat guide. A swivel table is not supplied unless by special arrangement, the footstock being provided with a cross adjustment for maintaining alignment. The grinding wheel head is also supported by a vee and flat guide, and is equipped with adjustable steel-back babbitt bearings which are lubricated continuously by filtered oil. A rapid electric wheel-head cross-movement enables the operator to move the massive wheel-head forward or backward quickly with little effort.

The Landis low-pressure hydraulic system provided includes a variable-flow oil pump and a continuous hydraulic motor. At no time is more oil pumped than is actually required, and this means that the pump never works at maximum capacity unless required to do so by heavy demands of the machine. The motor is of the two-chamber type and is capable of being rotated any number of revolutions in one direction, reversed and then rotated any number of revolutions in the opposite direction.

In order to obtain the desired amount of crown or concavity, it is only necessary to set and lock in position two dials at the rear of the wheel-base. The crowning and concaving mechanism is driven from the carriage drive. A diamond-holder is clamped to the work-table for truing the face of the wheel slightly convex so that the grinding action does not all take place on the wheel edges.

The headstock is driven by a dynamically balanced variable-speed motor through multiple V-belts and worm-gearing. A field rheostat gives a wide range of work speeds. If direct current



Cincinnati Plain Heavy-duty Grinding Machine Intended for a Variety of Work

is not available, a generator is mounted at the rear of the machine and driven by a silent chain from the water pump shaft. The main drive motor is placed at the rear of the bed.

CINCINNATI HEAVY-DUTY GRINDING MACHINE

The heavy-duty grinding machine here illustrated has been recently built by Cincinnati Grinders, Inc., Cincinnati, Ohio, for operations on large work of a limited number of similar parts. This plain, self-contained grinder will swing work up to 28 inches in diameter over the work-table and up to 40 inches in diameter in the gap. The maximum length between centers is 48 inches.

The table gap allows for grinding work of large diameter and comparatively short length, such as flanged spindles and gear blanks. It is especially suited to the grinding of locomotive pistons and piston-rods with one handling of the sub-assembly. The length of the gap can be varied proportionately to the length of table traverse provided.

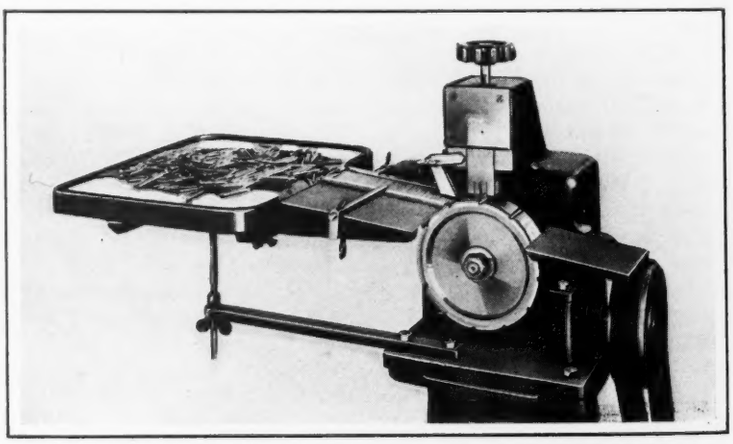
The continuous pressure-feed oiling system to the table ways includes a "Purolator" oil filter. This lubricating arrangement permits the table to float on a constant film of clean oil between its ways and the bed.

The rapid traverse to the wheel-slide unit expedites the grinding of parts having several diameters varying considerably in size, as, for example, machine tool spindles with unusually large flanges. The work-head is equipped with a variable-speed motor which, in conjunction with a rheostat mounted on the front of the machine, provides an infinite number of speeds within a three-to-one range.

A motor-driven vertical coolant pump is provided at the rear of the machine. The rotor of this pump is below the level of the coolant supply tank, thus eliminating the necessity of priming. The coolant control valve is located directly over the pump and is operated by means of a rod that projects through the bed of the machine for the convenience of the operator.

NOBLE & WESTBROOK MARKING MACHINE

An improved model of the No. 19 power-operated "Rapid Production" marking machine made by the Noble & Westbrook Mfg. Co., 20 Westbrook St., East Hartford, Conn., has been brought out for marking small cylindrical pieces from about 1/16 to 3/4 inch in diameter and from 1 to 4 inches long. The machine is



Noble & Westbrook Marking Machine for Small Cylindrical Parts

MACHINERY'S DATA SHEETS 171 and 172

DATA FOR DESIGNING MULTIPLE-SPINDLE DRILL HEADS—1

Diameter of Drill	Drilling Machine Steel (S. A. E. No. 1020) Feed, 3 Inches per Minute					Drilling 0.70 Per Cent Carbon Steel Feed, 2 Inches per Minute					Drilling Nickel-Chromium Steel Feed, 1.5 Inches per Minute				
	Cutting Speed, Feet per Minute	Spindle Speed, Revolutions per Minute	Feed per Revolution, Inches	Feeding Pressure, Pounds	Horsepower Required	Cutting Speed, Feet per Minute	Spindle Speed, Revolutions per Minute	Feed per Revolution, Inches	Feeding Pressure, Pounds	Horsepower Required	Cutting Speed, Feet per Minute	Spindle Speed, Revolutions, Per Minute	Feed per Revolution, Inches	Feeding Pressure, Pounds	Horsepower Required
1/4	36.4	555	0.0054	260	0.12	31.9	488	0.0041	276	0.12	26.0	395	0.0038	285	0.12
5/16	39.6	484	0.0062	350	0.20	34.0	417	0.0048	365	0.20	27.0	340	0.0044	380	0.20
3/8	42.1	428	0.0070	450	0.28	35.7	364	0.0055	465	0.28	29.5	300	0.0050	485	0.28
7/16	44.2	385	0.0078	570	0.37	37.0	322	0.0062	580	0.37	30.7	268	0.0056	600	0.37
1/2	45.7	349	0.0086	700	0.47	38.0	290	0.0069	695	0.47	31.7	242	0.0062	725	0.47
9/16	47.0	319	0.0094	840	0.60	38.8	263	0.0076	830	0.60	32.5	220	0.0068	860	0.60
5/8	48.2	294	0.0102	990	0.74	39.5	241	0.0083	975	0.74	33.2	203	0.0074	1000	0.74
11/16	49.1	272	0.0110	1160	0.90	40.0	221	0.0090	1130	0.90	33.8	188	0.0080	1150	0.90
3/4	50.0	254	0.0118	1340	1.06	40.5	206	0.0097	1290	1.06	34.2	174	0.0086	1310	1.06
13/16	50.7	238	0.0126	1530	1.24	40.9	193	0.0104	1460	1.24	34.7	163	0.0092	1480	1.24
7/8	51.3	224	0.0134	1740	1.45	41.3	180	0.0111	1650	1.45	35.1	153	0.0098	1665	1.45
15/16	51.9	211	0.0142	1950	1.67	41.7	169	0.0118	1840	1.67	35.4	144	0.0104	1850	1.67
1	52.4	200	0.0150	2200	1.90	42.0	160	0.0125	2050	1.90	35.7	136	0.0110	2050	1.90
1 1/8	53.3	181	0.0166	2680	2.40	42.4	144	0.0139	2500	2.40	36.3	123	0.0122	2500	2.40
1 1/4	54.0	165	0.0182	3180	2.97	42.7	131	0.0150	3000	2.90	36.6	112	0.0134	3000	2.90
1 3/8	54.6	151	0.0198	3800	3.50	43.0	120	0.0160	3550	3.50	37.0	103	0.0146	3550	3.50

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DATA FOR DESIGNING MULTIPLE-SPINDLE DRILL HEADS—2

Diameter of Drill	Drilling Aluminum Feed, 9 Inches per Minute					Drilling Cast Iron Feed, 5 Inches per Minute					Drilling Semi-Steel Feed, 4 Inches per Minute				
	Cutting Speed, Feet per Minute	Spindle Speed, Revolutions per Minute	Feed per Revolution, Inches	Feeding Pressure, Pounds	Horsepower Required	Cutting Speed, Feet per Minute	Spindle Speed, Revolutions per Minute	Feed per Revolution, Inches	Feeding Pressure, Pounds	Horsepower Required	Cutting Speed, Feet per Minute	Spindle Speed, Revolutions, Per Minute	Feed per Revolution, Inches	Feeding Pressure, Pounds	Horsepower Required
1/4	131	2000	0.0040	47	0.07	54.6	834	0.006	230	0.10	46.0	702	0.0057	250	0.10
5/16	145	1760	0.0045	58	0.10	58.5	715	0.007	290	0.15	49.5	606	0.0066	335	0.15
3/8	157	1600	0.0050	68	0.15	61.5	625	0.008	360	0.22	52.0	533	0.0075	420	0.22
7/16	167	1450	0.0055	81	0.20	63.5	555	0.009	440	0.30	54.5	476	0.0084	515	0.30
1/2	175	1330	0.0060	95	0.26	65.5	500	0.010	520	0.39	56.3	430	0.0093	615	0.39
9/16	181	1230	0.0065	108	0.33	66.8	454	0.011	610	0.50	57.6	392	0.0102	725	0.50
5/8	187	1140	0.0070	124	0.40	68.0	416	0.012	720	0.62	58.8	360	0.0110	845	0.62
11/16	192	1065	0.0075	140	0.50	69.3	385	0.013	820	0.75	59.9	333	0.0120	970	0.75
3/4	197	1000	0.0080	157	0.59	70.0	357	0.014	930	0.89	60.8	310	0.0129	1095	0.89
13/16	201	940	0.0085	175	0.69	70.7	333	0.015	1050	1.04	61.7	290	0.0138	1230	1.04
7/8	204	890	0.0090	195	0.80	71.5	312	0.016	1175	1.20	62.3	272	0.0147	1365	1.20
15/16	207	842	0.0095	215	0.92	72.2	294	0.017	1310	1.38	62.9	256	0.0156	1520	1.38
1	210	800	0.0100	235	1.04	72.8	278	0.018	1460	1.57	63.6	242	0.0165	1680	1.57
1 1/8	214	727	0.0110	280	1.22	73.8	250	0.020	1760	2.00	64.3	218	0.0180	1995	2.00
1 1/4	218	666	0.0120	330	1.65	74.6	228	0.022	2120	2.45	65.2	199	0.0200	2350	2.45
1 3/8	222	615	0.0130	380	1.96	75.0	208	0.024	2470	3.00	66.00	183	0.0220	2750	3.00

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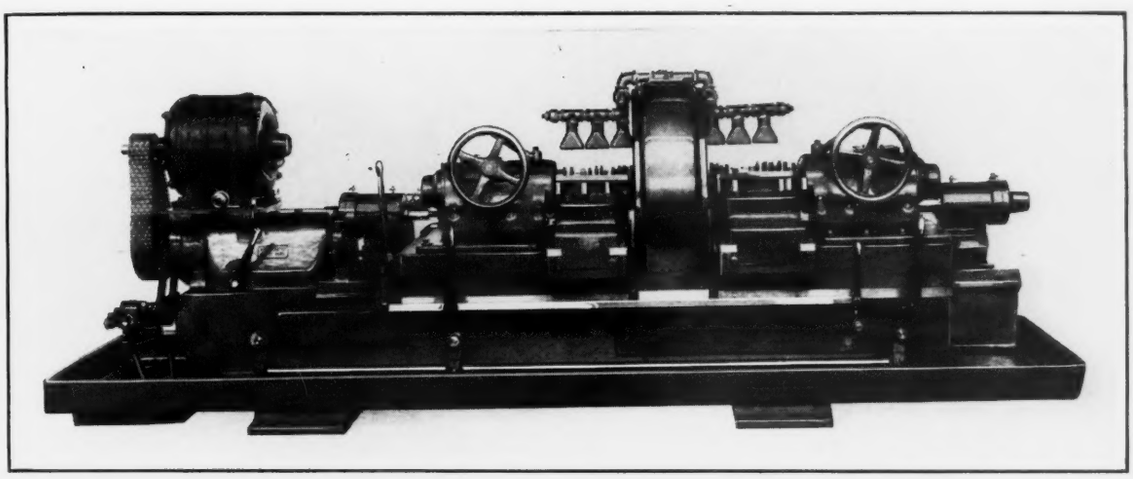


Fig. 1. Foster Center-drive Machine for Turning and Facing Large Crankshafts

equipped with a motor drive, the dial being driven through worm-gearing which runs in oil.

The loading platform has an inclined surface which brings the work to the marking dial. A pick-up dial provides for bringing small work straight across the dial. Various sizes of pick-up dials are required for different sizes of work. Larger parts can be marked successfully without a pick-up dial.

The operation of feeding the machine consists merely of keeping the inclined platform filled from the loading platform, the operator sorting out the work. In the operation illustrated, roller-bearing tie-rods are being marked, but straight-shank drills and taps can also be handled.

All feeds are hydraulically operated by Oilgear equipment. In Fig. 1 the machine is illustrated with the chain guards removed so as to show the method of driving. The crank arms are 12 inches long and 3 1/4 inches in diameter. The average time for rough-turning is 6 minutes.

FOSTER CENTER-DRIVE MACHINE

A special machine recently built by the Foster Machine Co., Elkhart, Ind., simultaneously turns the two arms of a large crankshaft and faces the outside surfaces of the cheeks, several shoulders, and the ends. The crankshaft is supported on four centers, two of which are carried in the central driving member of the machine and are of equalizing design. The other two centers are carried in the tailstocks and are supported in Timken tapered roller bearings. The driving member rotates on roller bearings and is driven through herringbone gears. A front view of this machine is illustrated in Fig. 1.

Gangs of cutters at the rear of the work, as shown in Fig. 2, feed longitudinally for the turning cuts. Through the action of cams, the cutter gangs on the front side of the work are fed crosswise to perform the operations of facing the outside of the throws, as well as the ends and shoulders. All operations are completed simultaneously, and upon their completion, the entire tooling is backed to the starting positions, clear of the work.

VERSON ALL-STEEL INCLINABLE PRESSES

Steel plate is substituted almost exclusively for iron castings in a line of all-steel inclinable presses now being introduced to the trade by the La

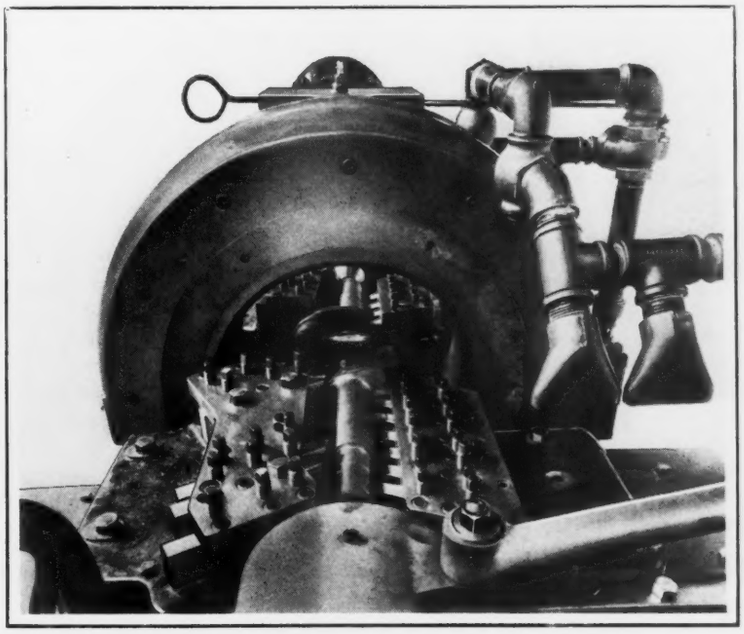
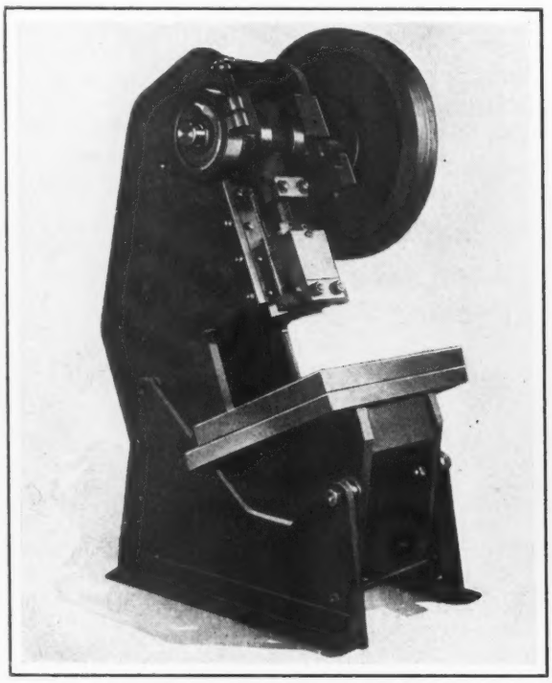
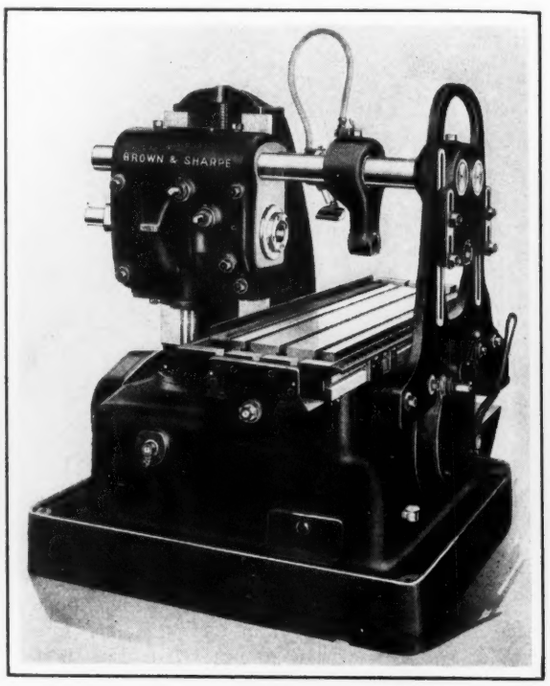


Fig. 2. View of the Tooling and Central Driving Member



Verson All-steel Inclinable Press



Brown & Sharpe Redesigned Milling Machine

Salle Machine Works, Inc., 3013-17 S. La Salle St., Chicago, Ill. As illustrated, the bodies of these presses are fabricated entirely of steel plates cut to size and shape and electrically welded into units. It is claimed that exceptional strength and rigidity, together with minimum bulk, are obtained by this method. The plates are machined both before and after welding to insure lasting alignment.

These presses can be made to suit the exact requirements of the user. Work requiring unusual dimensions, such as a large die space, bed area, or depth of throat can be readily provided for.

BROWN & SHARPE PLAIN MILLING MACHINE

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently redesigned the No. 13B plain milling machine as here illustrated. Feed ranges and capacity dimensions are nearly the same as in the previous design; however, new features and improvements have been incorporated to increase production. The top of the table is 32 inches above the floor, which is the usual conveyor height and one that has been found advantageous in reducing fatigue when work must be lifted to and from the floor. The position of the driving pulley at right angles to the table permits batteries of the machine to be driven from one lineshaft, thus occupying minimum floor space.

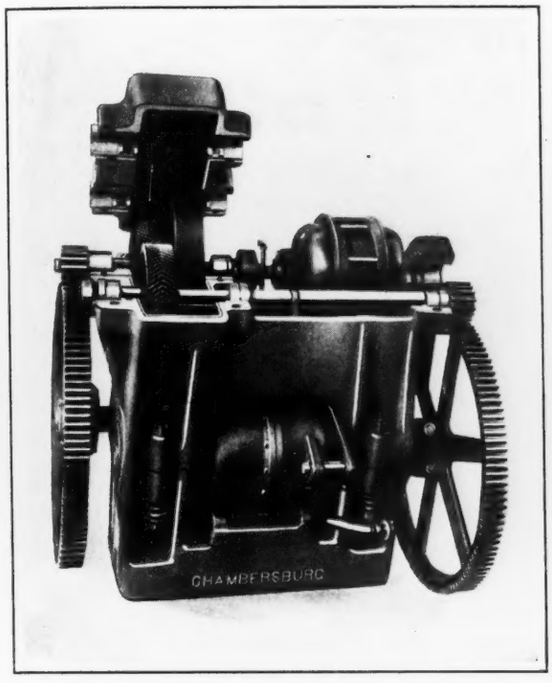
The bed, table ways, and column are cast in one piece. The table ways are 42 inches long and support the table for almost its entire length. About 4 inches of cross adjustment of the spindle is obtained through a 7 1/4-inch diameter sliding sleeve, which carries the spindle and its bearings. The spindle head may be readily adjusted owing to the method of gibbing employed. It is clamped in position by means of four bolts. Adjustments are made through a long movable nut that is mounted on the stationary screw.

The entire table top is finished to serve as a working surface. Feeding of the table is accomplished through the use of a revolving nut on a large stationary screw. Over-arms of the double type are provided. The arbor yokes, cutters, and arbor can be removed without disturbing the outer brace.

Power is transmitted to the machine through a self-adjusting multiple dry-disk clutch, and the drive is entirely through splined shafts and gears. Anti-friction bearings are used extensively. The machine can be operated with entirely automatic table functions, when desired. A variety of operating cycles can be obtained by means of adjustable dogs. One lever controls all power movements of the table.

CHAMBERSBURG BOARD DROP-HAMMER WITH MOTOR-DRIVEN HEAD

A Model H board drop-hammer equipped with an individual motor drive is the latest development of the Chambersburg Engineering Co., Chambersburg, Pa. The new motor-driven head, here illustrated, is identical to the belt-driven head of the Model H



Motor-driven Head for Chambersburg Board Drop-hammer

Lincoln Machine which Automatically Welds Wire Wheels

machine described in February, 1929, MACHINERY, page 462, with the exception that the motor and driving assembly are mounted on a bracket which replaces the caps over the eccentric bearings of the belt-driven head. The motor is spring-mounted and shielded from the heat of forging. A gear drive to the roll-shafts insures uniform speed of the front and rear rolls and eliminates "grinding" of the boards.

The motor drives the rear roll drive-shaft through a metal flexible coupling. Power is transmitted to the front roll drive-shaft by means of a pair of herringbone gears which run in a spray of oil. A balanced flywheel on the rear shaft protects the motor from variations in the load. The hammer will operate for several blows without power.

At the opposing ends of the front and rear drive-shafts there are non-metallic pinions which mesh with steel gears on their respective roll-shafts. All shafts are mounted in Hyatt roller bearings. By the direct application of power through gears, loss of speed due to slippage of belts or lagging of chains is eliminated.

LINCOLN WIRE-WHEEL WELDING MACHINE

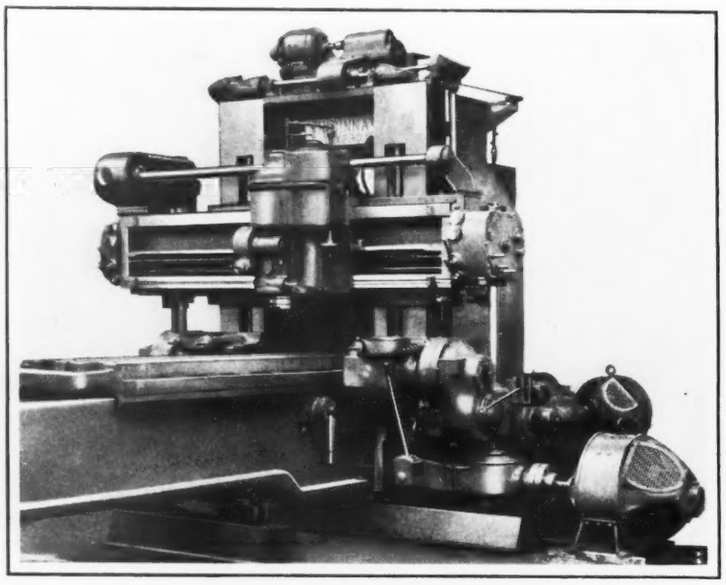
An automatic machine for manufacturing wire wheels by the carbon arc-welding process has recently been brought out by the Lincoln Electric Co., Coit Road and Kirby Ave., Cleveland, Ohio, primarily for use in the automotive industry. This machine makes a lap weld to join the pressed-steel parts inside the hub as the wheel turns in a jig. The welding time for an 8-inch hub, such as the one shown in the illustration, is 40 seconds, and the floor-to-floor production on this size wheel is fifty per hour.

The machine employs the "electronic tornado" principle. Metal filler rod, such as is generally used in automatic welding, is unnecessary, the metals of the hub being fused together as they rotate in the jig.

GENERAL ELECTRIC AUTOMATIC WELDING-ELECTRODE FEEDING DEVICE

An improved feeding device has been developed by the General Electric Co., Schenectady, N. Y., for the automatic welding head manufactured by this concern. This device has been designed to meet advances in the art of automatic welding which call for high welding speeds requiring heavier welding currents and larger sizes of electrode wire than have ordinarily been used heretofore. The improvement consists of the addition of a geared drive to what was formerly the idler roller in the feeding mechanism. In this way, large sizes of wire which are stiff and hard to feed without an excessive pressure on the driving rolls are positively fed without slippage at a regular rate and with only a moderate pressure between the driving rolls.

This device also makes possible the use of curved nozzles in automatic welding for reaching inaccessible places. Any size of wire from 1/8 to 1/4 inch in diameter can be accommodated without changing gears. For wire less than 1/8 inch in diameter, the gears are not needed and so are disengaged.



Cincinnati Heavy-duty Planer-type Milling Machine

CINCINNATI PLANER-TYPE MILLING MACHINE

A heavy-duty 30- by 30-inch planer-type milling machine has been added to the line of machines of this class built by the Cincinnati Planer Co., Cincinnati, Ohio. Several improvements have been incorporated in this machine. The table- and feed-control lever operates the table for either the rapid traverse or the feed, and the arrangement is such as to prevent the traverse and feed from being engaged at the same time. This lever engages the feed to the head as well as to the table.

The drive to the spindles has been placed on the right-hand side for side-heads, and on the left-hand side for rail heads. All drive shafts are driven through spiral-bevel gears which run in oil. The shafts are mounted in Timken tapered roller bearings.

DIAMOND HYDRAULIC FACE-GRINDING MACHINE

The principal features of the latest type of face-grinding machine built by the Diamond Machine Co., 9 Codding St., Providence, R. I., include a hydraulic table drive, electrically operated feeds, a variable table speed, and concentration of controls at the operator's position. The table is driven by means of a low-pressure oil cylinder and piston. Oil is supplied to the cylinder by a pump driven by a 7 1/2-horsepower motor running at 1200 revolutions per minute.

A valve which controls the reversing of the table is operated by electric solenoids. These solenoids become energized when dogs on the table trip a lever which opens and closes electric switches. The same switches make and break the electrical circuit to a solenoid which operates an automatic cross-feed at each reversal of the table. The cross-feed range is from 0.001 to 0.01 inch. Cross-feed by hand is effected through a handwheel.

Table speeds of from 20 to 60 feet per minute are available by moving a single lever. Fast speeds are usually employed for rough grinding, and slow speeds for finish grinding. It is mentioned that the fast speeds are of distinct advantage in grinding long knives, shear blades, etc., made of hardened steel, as the blades or knives may be ground without "burning," since the grinding wheel is not in contact with any particular area of metal long enough to cause excessive heating. A permanent truing device is provided for dressing the grinding wheel without stopping.

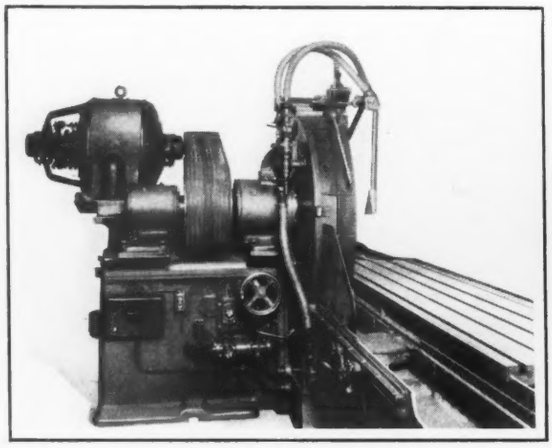


Fig. 1. Operating Side of Diamond Face-grinding Machine with Hydraulic Drive

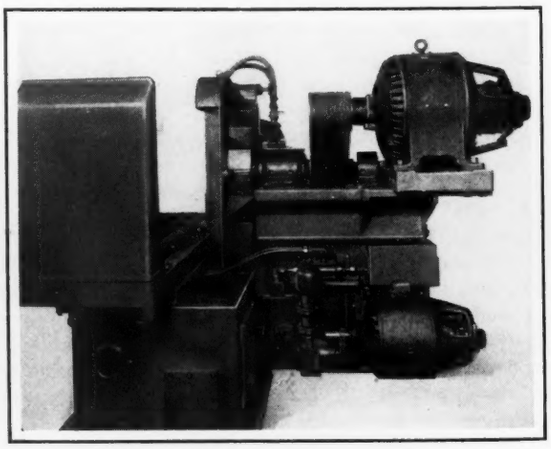
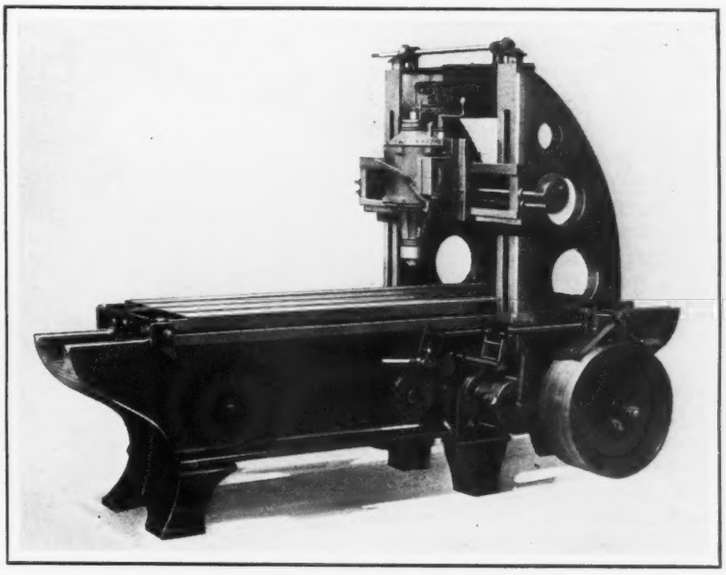


Fig. 2. View of Hydraulic Drive on Diamond Face-grinding Machine

The abrasive wheel is of the segmental type, and is held in a patented wheel chuck mounted on a large spindle that runs in Timken tapered roller bearings. It is driven by a 40-horsepower motor running at 1200 revolutions per minute, the power being transmitted through a silent chain and sprockets or through a V-belt drive, as illustrated. The V-belt drive consists of large motor and spindle sheaves having ten V-shaped grooves in which fabricated rubber V-belts run. As in the case of the silent chain drive, the V-belt drive may be adjusted by moving the motor along its base.

Coolant is supplied to the abrasive wheel by a vertical-spindle pump of the impeller type, which is driven direct by a 3/4-horsepower motor. The standard machine has wheels 30 or 36 inches in diameter and a table 86 inches in length by 24 inches in width. The 30-inch machine will grind work 20 inches high with the lower front-wheel guard in place, and 24 inches high with the guard removed. This guard is made of aluminum so that it can be easily removed for grinding high work.



Cincinnati Planer Equipped with Grinding Head

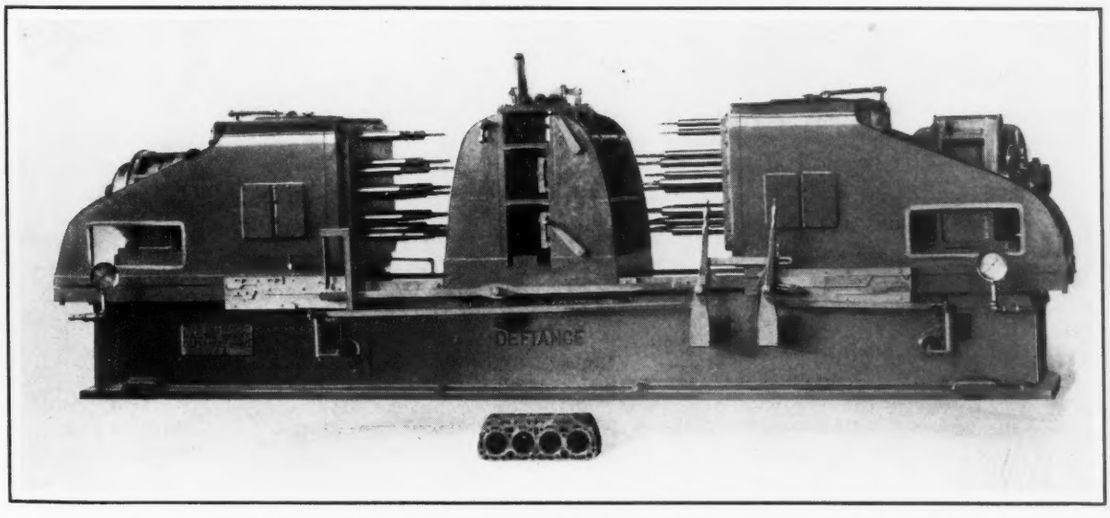
CINCINNATI PLANER WITH GRINDING HEAD

The Cincinnati Planer Co., Cincinnati, Ohio, has developed a special grinding attachment which may be applied, as illustrated, to any size of planer. In the illustration, a 30-inch medium-pattern planer is shown arranged for grinding with a cup-wheel. The grinding head is driven by a three-horsepower motor. Up and down movements for setting the wheel can be made from the end of the rail or by means of the crank-handle on the head. The head can be moved across the work by power.

This attachment is also made for grinding on the periphery of the wheel. Both types have a large application in die shops and tool-rooms. The standard planer head can be left on the rail if general planing is to be done on the same machine. With the patented "Tu-Speed" countershaft, two table speeds are available.

DEFIANCE TWO-WAY DRILLING MACHINE

The horizontal multiple-spindle drilling machine here illustrated is built by the Defiance Machine Works, Defiance, Ohio,



Defiance Multiple-spindle Two-way Drilling Machine with Seventy-seven Drill Spindles

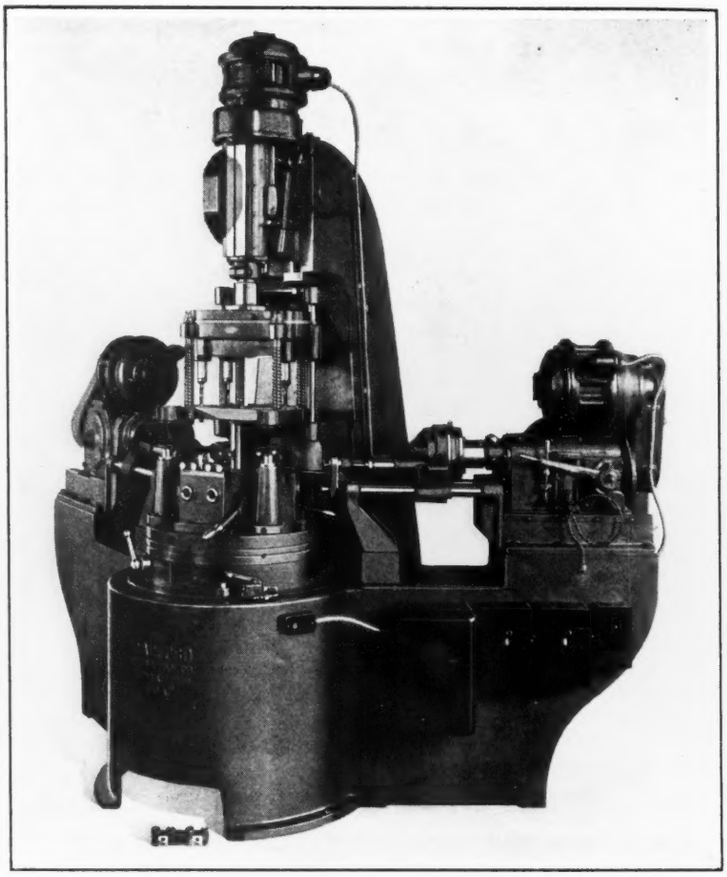
primarily for drilling the holes in all the sides of a cylinder head casting. This machine is also adaptable to the production drilling of cylinder blocks, transmission cases, and similar work. The drill heads and fixture are always built to suit the particular requirements for which the machine is intended.

The spindles of the fixed-center heads are driven by stub tooth gears which are enclosed and continuously oiled by a force-feed system. There are 77 spindles in the two heads. One head is driven by a 30-horsepower motor, and the other by a 40-horsepower motor, the motor speeds being 1200 revolutions per minute. Flexible couplings connect the motors direct to the heads.

The fixture is of a three-station design so that the drilling of all holes can be accomplished at one cycle of the machine as the cylinder head progresses from the first to the third station. Two Oilgear pumps move the heads independently of each other. One head travels in advance of the other, drilling through the center of the work and starting reversing before the second head reaches the center. Several holes are drilled clear through on this job.

The stroke of each head is 24 inches, there being a rapid traverse forward, then a feed at the desired rate for the actual cutting, next an automatic kick-off, and finally, an automatic return. The heads move away from the fixture sufficiently to permit changing the tools. In the operation illustrated, one cylinder head is completely drilled every 4 minutes, including the time for loading and unloading.

The machine can also be fitted with a mechanical screw feed instead of the Oilgear feed, if desired. Three-horsepower motors, running at 900 revolutions per minute, are employed for driving the Oilgear pumps. The machine occupies a floor space of approximately 17 by 5 feet, and has a weight of 27,500 pounds.



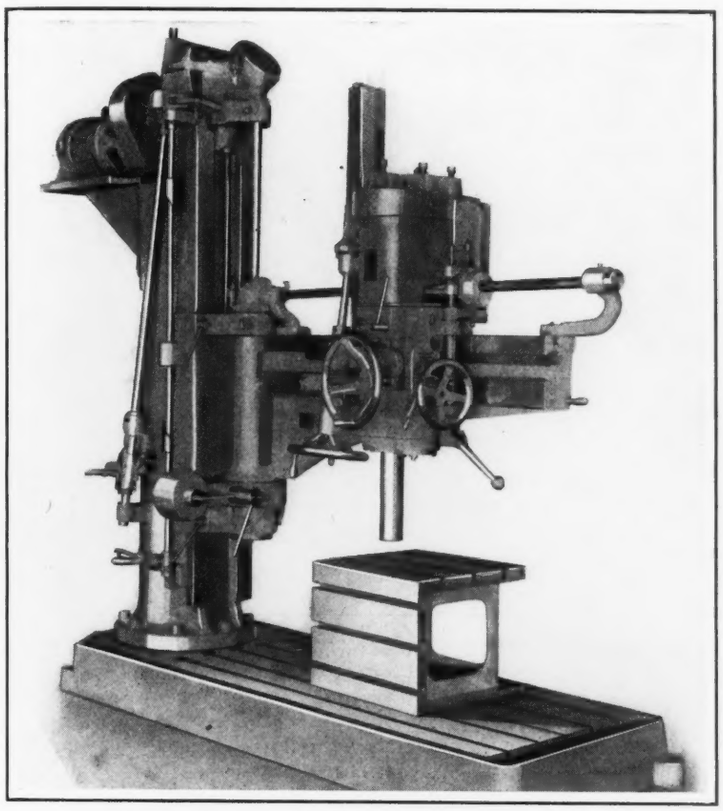
Bradford Three-way Machine Designed for Drilling and Reaming Automobile Valve Tappet Guides

BRADFORD THREE-WAY DRILLING AND REAMING MACHINE

A three-head machine recently built by the Bradford Machine Tool Co., 657-671 Evans St., Cincinnati, Ohio, for drilling and reaming automobile valve-tappet guides is shown in the accompanying illustration. This machine performs the operation of drilling and rough-reaming four holes 0.613 inch in diameter by 1 15/16 inches deep; two 29/64-inch holes; and two 19/64-inch holes. The parts are iron castings, and the floor-to-floor time is 53 seconds.

This machine is equipped with a three-station indexing fixture. In the first station, which is at the front of the machine, the fixture is loaded and unloaded. In the second position, which is to the left of the operator, the four large holes are drilled to a diameter of 39/64 inch by the horizontal head and the 29/64-inch holes are drilled by the vertical head. In the third position, the four 0.613-inch holes are reamed by the right-hand horizontal head and the 19/64-inch holes are drilled by the vertical head.

The work-fixture is indexed by hand progressively through the two working stations, so that one part is finished at each cycle of the machine. A small hand-valve mounted at the front of the machine connects air cylinders attached to the trip-levers of all heads. Thus all spindles are caused to advance simultaneously to perform their respective operations, after which they return to their starting points and stop. A push-button switch controls the main line circuit. Each motor has an independent switch with a fuse and overload protection.



Latest Model of Western Radial Drilling Machine with Drive Close to Spindle Nose

WESTERN "LOW HUNG DRIVE" RADIAL DRILLING MACHINES

The latest model of "Low Hung Drive" radial drilling machines built by the Western Machine Tool Works, Holland, Mich., is here illustrated. As the name implies, machines of this line drive the spindle close to the nose or working end. The drill head is completely equipped with Timken tapered roller bearings. Another feature is the "Texrope" drive from the motor to the machine.

In order to insure accuracy of construction, the bottom of the column is scraped to the base. An eight-speed gear-box is mounted on the column. This box has but nine gears and only those actually transmitting power are ever in mesh. A combined air and hand clamp may be provided for the arm, as illustrated. This air clamp operates instantly and saves considerable time when the arm must be shifted frequently. Should the air supply fail, the clamp can be operated by hand.

All operations are controlled through a ball-handle lever at the right of the head. A tapping attachment is furnished regularly, which is also controlled by this lever. The operator can run the tap into the work in back-gear, and when the required depth is reached, he can reverse the tap at five times the driving speed, by imparting another movement to the ball-handle lever.

These machines are built in seven sizes, as follows: 3, 3 1/2, 4, 5, 6, 7, and 8 feet. The net weights range from 5600 to 20,750 pounds.

"ADACHROME PLASTIC SUPER-CEMENT"

A cement having a bonding agent which is efficient at high temperatures has been brought out by the Botfield Refractories Co., Swanson and Clymer Sts., Philadelphia, Pa., under the trade name of "Adachrome Plastic Super-cement." The basic material of this cement is a high-grade chromite ore obtained from South African deposits. Because of its chromite base, the cement is said to be chemically inert and also hard, dense, and highly refractory. This material is suitable for use on furnaces employed in annealing, carburizing, casehardening, and other heat-treating operations.

"RIGIDMIL" WITH SPECIAL MILLING HEADS

A new model has recently been added to the line of "Rigidmil" milling machines built by the Sundstrand Machine Tool Co., Rockford, Ill. This model known as the No. 3-4, differs from the standard No. 3 "Rigidmil" in that certain modifications adapt it particularly to the use of special single- and multiple-spindle heads. The machine is heavier, has a higher column that provides greater flexibility for special heads, and has a compartment for chips, with a drop door for cleaning it out, in the base. The saddle and table are also of larger proportions and an increased minimum power-feed travel is provided. The feed control and table stops are protected from chips and coolant. The range of feeds and speeds is the same as on the standard model.

The machine may be built with a throat distance of either 12 5/8 or 17 1/2 inches, this being the distance from the spindle column to the center of the table. This provision makes possible the mounting of special heads on the spindle column for milling large or cumbersome pieces, without sacrificing the working surface of the table. This feature is illustrated in Fig. 3, where it will be seen that the ample throat distance permits the use of a special angular two-spindle head for milling bosses on an automobile-engine cylinder block. Fig. 1 shows the machine equipped with an eight-spindle

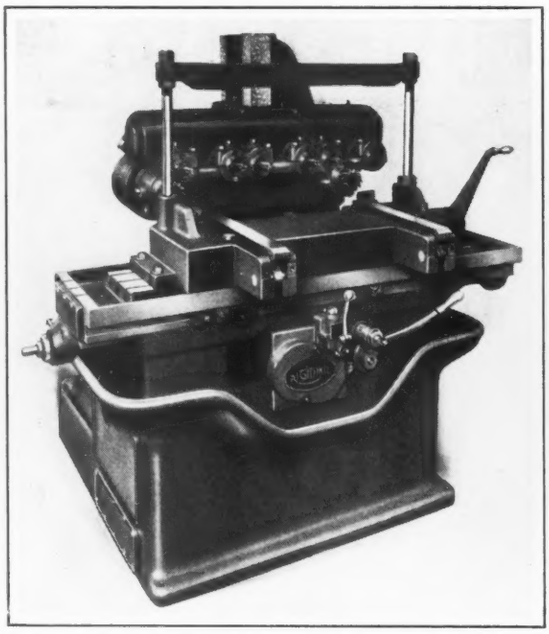


Fig. 1. Sundstrand "Rigidmil" Equipped with an Eight-spindle Milling Head

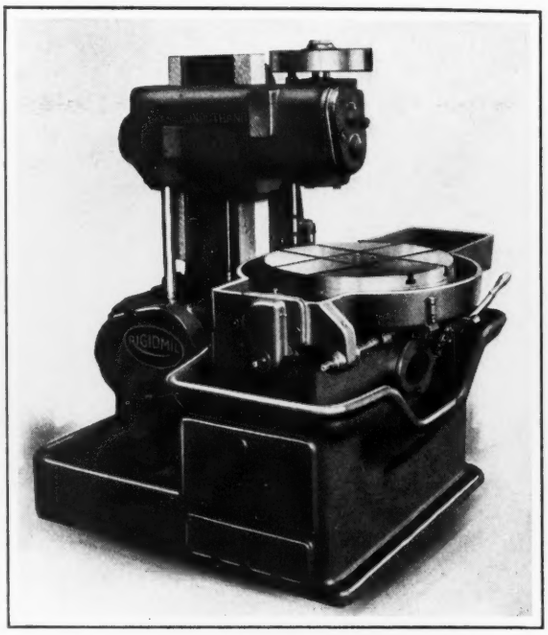


Fig. 2. "Rigidmil" Equipped with a Vertical Head and Rotary Table for Rotary Milling

head for milling eight bosses on a cylinder block.

Power feed and rapid travel to the table in both longitudinal directions are controlled through a single lever located at the front of the machine. Trip-blocks on the table automatically disengage the feed or rapid travel, the latter being set at 102 inches per minute. A control can be provided to return the table automatically to the starting or loading position upon the completion of the cut.

The spindle is carried at both the front and rear in Timken tapered roller bearings. The entire spindle assembly is carried in a hardened and ground steel quill having 3 1/2 inches of adjustment. The spindle is driven through spiral-bevel gearing from a one-piece pinion and shaft, also mounted in Timken bearings. A flywheel on the spindle eliminates vibration and chatter on heavy cuts.

Fig. 2 shows the machine arranged for rotary milling, a standard vertical head and a standard 24-inch rotary table being provided.

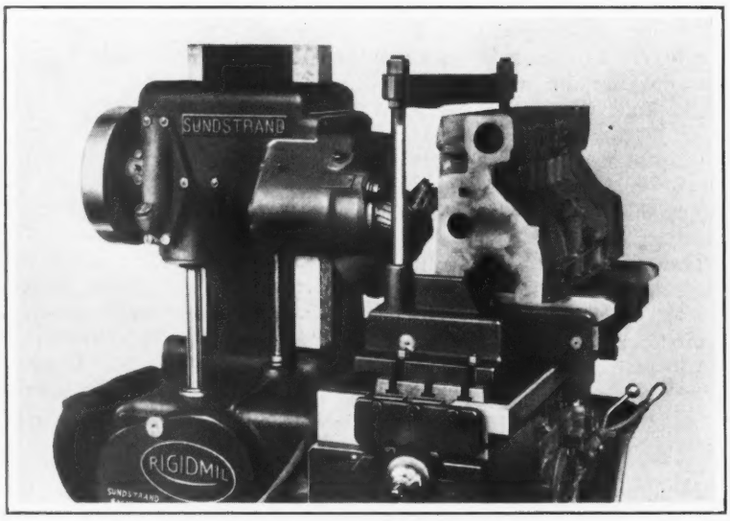


Fig. 3. Employing a Special Angular Two-spindle Milling Head

RANSOM GRINDING MACHINES

A No. 124 HS grinding machine recently built by the Ransom Mfg. Co., Oshkosh, Wis., to carry 36- by 3-inch wheels running at 9500 feet per minute is shown in Fig. 1. The motor is mounted in the base on a platform which is adjustable up and down by means of the screw at the front of the machine. The motor may be of 15 or 20 horsepower rating and drives the spindle through "Tex-ropes."

The spindle is 4 3/8 inches in diameter and runs in S K F ball bearings. The guards are made of rolled steel plate, electrically welded together. They are provided with exhaust pipe openings at the back. Since the guards remain stationary under all conditions, the exhaust pipes are never disturbed. The doors are hinged and held shut by steel latches. An adjustable tongue compensates for wheel wear.

Fig. 2 shows the rear view of a MRW machine brought out by the same concern, the front view being similar in most respects to

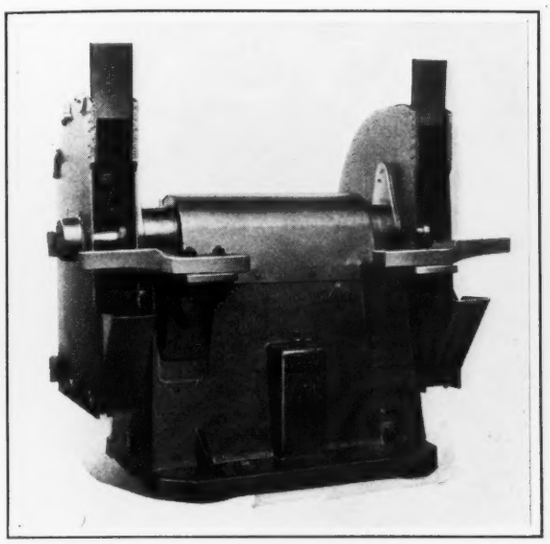


Fig. 1. Ransom Grinding Machine Built for 36-inch Wheels Running at 9500 Feet per Minute

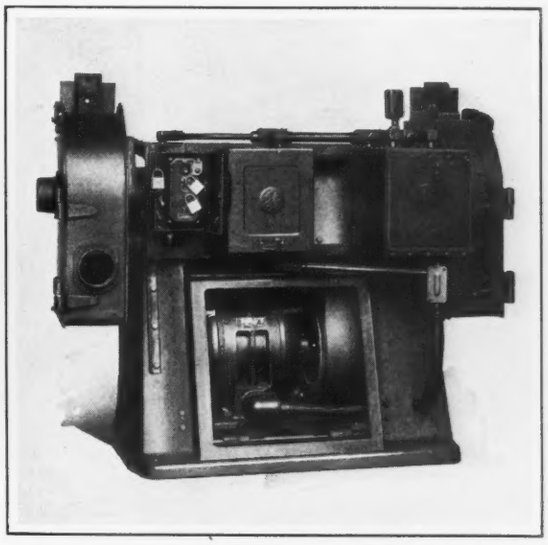


Fig. 2. Grinding Machine with Padlocked Three-button Switch for Controlling Motor Speeds

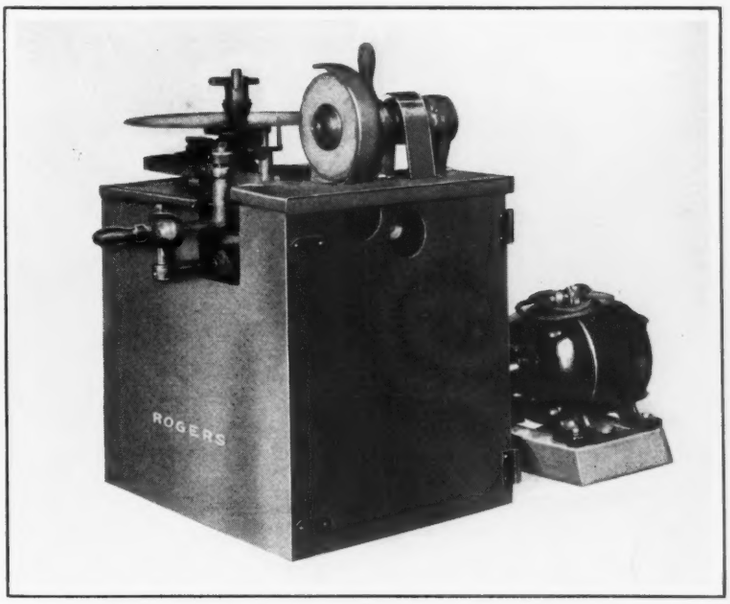
that of the machine illustrated in Fig. 1. This machine is equipped with 24- by 4-inch wheels and is also driven through "Texropes" by a 7 1/2-horsepower multi-speed ball-bearing motor. Motor speeds of 900, 1200, and 1800 revolutions per minute give a speed of 1025 revolutions per minute for the 24-inch wheels; 1370 revolutions per minute for wheels worn to 18 inches; and 2050 revolutions per minute for wheels worn to 12 inches.

Start and stop push-buttons are mounted above one of the enclosed starting panels facing the front of the machine. From the illustration, it will be noted that there is also a three-button switch, arranged with padlocks. This switch controls the speeds, and it is intended that some person be given charge of the key and made responsible for the speed in use. Only one of the buttons is supposed to be unlocked at any time.

This arrangement has the disadvantage that wheels can be changed without the knowledge of the man having charge of the key. At a slight additional charge, a controller device can be attached below the wheel which must be lowered before the wheel can be changed. The controller arm automatically operates a selective switch to give the right speed for the diameter of wheel. In this way, all possibility of over-speeding is avoided and the machine automatically operates at the proper speed when the arm is raised to the wheel. A full line of these machines is built for both vitrified and high-speed wheels, in sizes from 18 to 36 inches.

ROGERS AUTOMATIC CIRCULAR SAW SHARPENER

A new No. 4 machine designed for automatically gumming and sharpening wood-cutting, rip and cross-cut saws, and slitting and other metal-cutting saws as well, is a recent development of Samuel C. Rogers & Co., 191-205 Dutton Ave., Buffalo, N. Y. This sharpener is intended particularly for use in plants that do not require a heavier type of machine. It is designed to produce



Rogers Automatic Wood- and Metal-saw Sharpening Machine

satisfactory results in the hands of an unskilled operator.

The machine has positive adjustments for maintaining the same degree of bevel the entire length of the grind. Cross-cut saws with teeth beveled up to 40 degrees and with 10 points to the inch are sharpened in two operations by tilting the saw on a special chuck. The wheel grinds a bevel on the face of one tooth and on the back of the next. When the circumference of the saw has been sharpened in this manner, the saw is turned over and the operation repeated.

The machine is fully automatic for circular saws from 3 to 30 inches in diameter having teeth from 10 points to the inch up to those having a spacing of 2 1/4 inches. From thirty to fifty teeth are sharpened and jointed per minute, depending upon their size. The grinding-wheel spindle is mounted in two S K F ball bearings which take both radial and thrust loads. If desired, the machine can be operated also by hand.

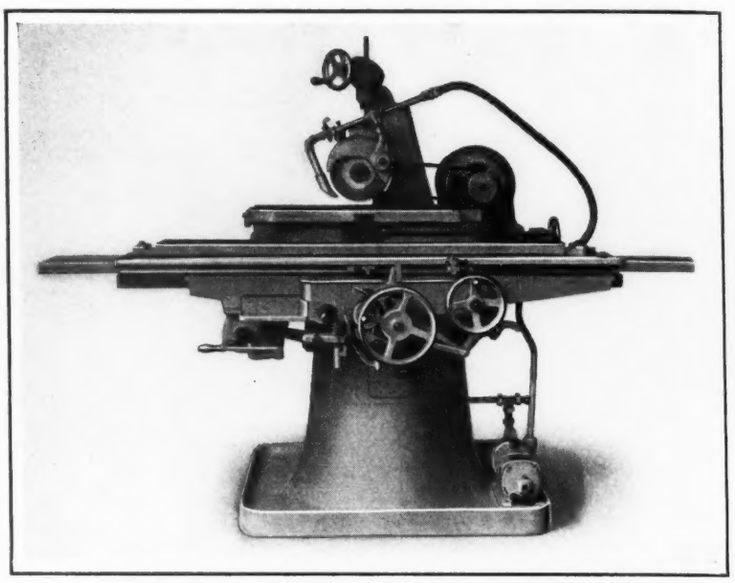


Fig. 2. Bath Grinding Machine Set up for Surface Grinding with Magnetic Chuck

BATH MOTOR-DRIVEN UNIVERSAL GRINDING MACHINE

The Bath universal grinding machine built by the Fitchburg Grinding Machine Corporation, Fitchburg, Mass., has recently been redesigned with the view to supplying power as close as possible to the points of demand and thus eliminating many shafts and bearings. The headstock is driven by a 1/4-horsepower motor; the wheel-spindle, by a 3-horsepower motor; the traverse mechanism, by a 3/4-horsepower motor; and the pump, by a 1/4-horsepower motor. The headstock and pump motors are included in the regular machine equipment, while the spindle-drive and traverse-drive motors are supplied by the customer and attached at the factory of the machine builder. The spindle-drive motor is supported on double arms built into the column of the machine, while the traverse-drive motor is attached to the knee.

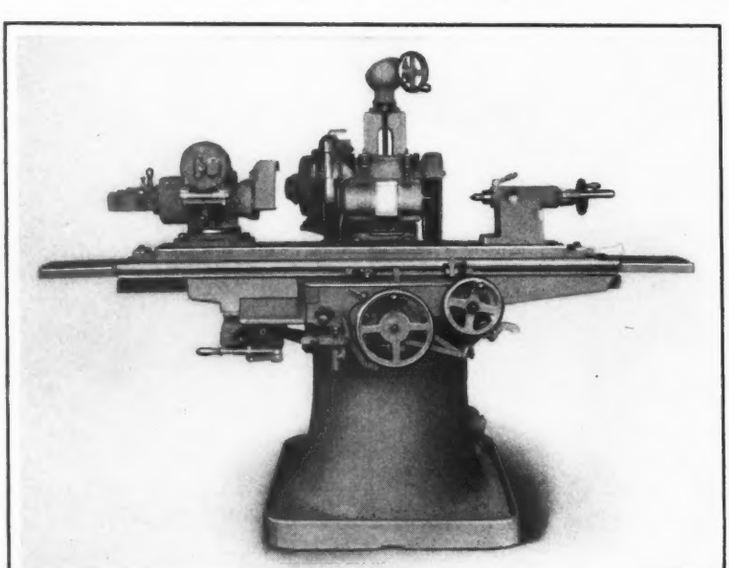


Fig. 1. Bath Redesigned Motor-driven Universal Grinding Machine

The wheel-head has a vertical movement only, effected through an elevating screw having a micrometer handwheel, which reads to 0.001 inch. Five speed changes of the headstock spindle are obtained by means of a sliding key. The spindle can be used for live- or dead-center work. The base is graduated to swivel 90 degrees.

Five table traverse speeds are obtainable through a sliding-key gear-box which has been redesigned to give longer wear. The swivel table swings on a central stud. Clamps are furnished for holding this table in desired settings. The automatic cross-feed has a range of from 0.00025 to 0.0025 inch at each reversal of the table. When a complete surface attachment is ordered, the automatic surface feed is furnished, which has a range of from 0.0025 to 0.025 inch at either or both table reversals.

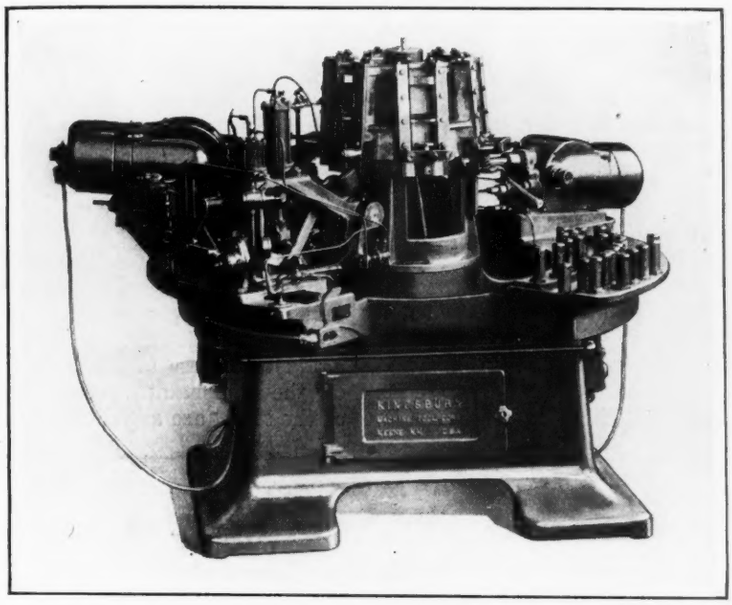


Fig. 1. Kingsbury Machine Designed for Drilling Cotter-pin Holes in Cooke Pins

Internal grinding equipment is regularly supplied with the machine. For surface grinding, the machine is arranged as illustrated in Fig. 2. To provide for the application of a magnetic chuck, a motor-generator unit can be furnished in place of the traverse-drive motor to drive the traverse mechanism and also generate direct current for the magnetic chuck. This machine is built in two sizes of 10 by 25 inches and 12 by 36 inches, respectively. The smaller dimensions indicate the normal swing over the table, and the larger dimensions, the maximum distance between the centers. The two sizes of machines weigh 4200 and 4400 pounds, respectively.

KINGSBURY "COOKE-PIN" DRILLING MACHINE

A machine has recently been developed by the Kingsbury Machine Tool Corporation, Keene, N. H., for automatically drilling the cotter-pin holes in "Cooke pins." These pins are of the construction shown in Fig. 2, and are used especially by railroads as brake pins. Three holes are drilled, as shown in the sectional view, so that a cotter-pin driven into hole *A* will spread automatically when it strikes the sharp edge formed by the intersection of holes *B* and *C*. A small ledge or shoulder left at the bottom of holes *B* and *C* prevents the cotter-pin from entering either of those holes.

The drilling machine consists primarily of an automatically indexed turret and three Kingsbury No. 30 automatic drilling heads. The machine table is made with an opening in the center to allow chips and coolant to fall through into a chip pan inside the cabinet base. An opening at the rear of the base provides for chip removal, while the coolant runs through strainers into the sump.

From the loading station at the front of the machine, the turret indexes to the left where hole *A* is drilled by the first head. This head has a spindle extension passing through the turret base and drills the hole from inside the turret. The pins are clamped in V-blocks by a screw tightened through the application of a wrench. This screw, necessarily being placed some distance above the end of the pin being drilled, does not take the thrust of the inside drill. At this station, therefore, an external clamp lever is provided, which performs the double duty of taking the drilling thrust and locking the turret in position. This clamp lever is operated by an air cylinder. The mechanism is designed as an individual unit, and is shown with the cover removed.

Holes *B* and *C* are drilled by the two remaining heads at subsequent stations. These heads are mounted on angular adapter plates, so that all three drilled holes will be in the same plane, square with the axis of the pin. Since the converging point of the center lines of holes *B* and *C* varies with respect to the turret center when drilling pins of different diameters, these two adapter plates are adjustable on the machine table. The particular machine illustrated accommodates pins from 1 to 2 1/2 inches in diameter and from 2 1/2 to 12 inches in length.

Automatic indexing of the turret is obtained by means of a Geneva mechanism operated by a motor-driven friction clutch inside the base. Synchronization of the turret index, lever clamp, and spindle stroke is obtained by the use of compressed air and a series of regulating valves. This

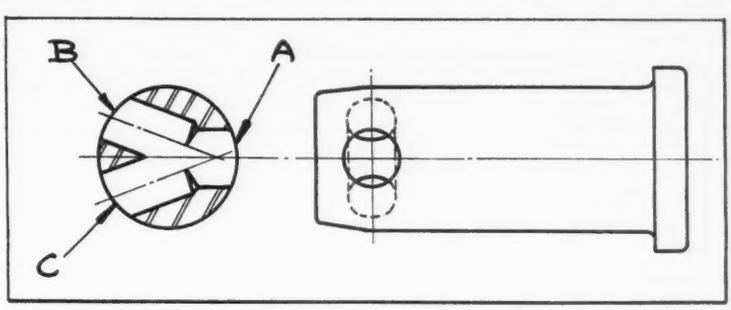


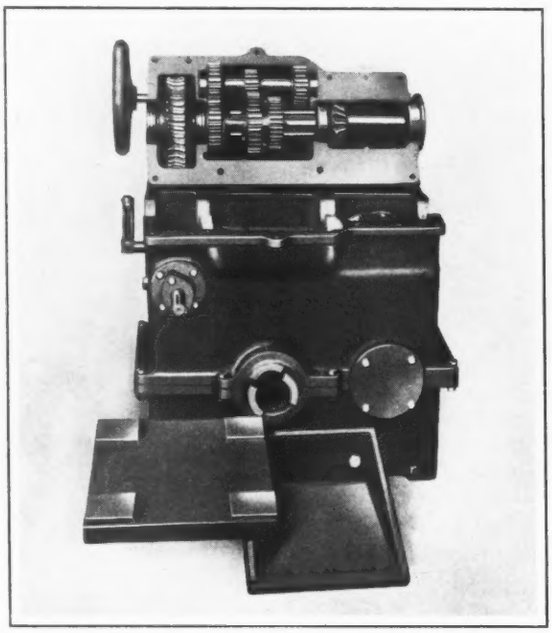
Fig. 2. Type of Pin Drilled in the Machine Shown in Fig. 1

method enables the operator to run the machine either fully or semi automatically. In semi-automatic operation, the turret does not index until the operator trips a control valve.

THREE-SPEED GEAR REDUCER

In a three-speed reducer recently developed by Gears & Forgings, Inc., 3122 Woodhill Road, Cleveland, Ohio, changes in speed are accomplished by turning a handwheel to operate a threaded shaft on which a shifting fork is mounted. The change-gear box consists of a splined shaft, as illustrated, which is an extension of a worm-gear shaft mounted in two sets of Timken roller bearings. Also, there is a jack-shaft on which two sets of change-gears are mounted. The sliding gears on the splined shaft engage either one of these change-gears or, by means of a clutch, engage the gear mounted on the worm-gear shaft.

The same concern has also recently developed a two-speed drive for use in the heavy machinery field. One of these units has been installed for driving a slabbing mill in a large steel plant. A feature of this unit is that no clutch parts are located inside the drive, the clutch being external, and attached to the intermediate shaft. The prime mover is a 1000-horsepower motor. The over-all dimensions of this drive are 26 feet long by 17 feet wide, and the total weight is 350,000 pounds.

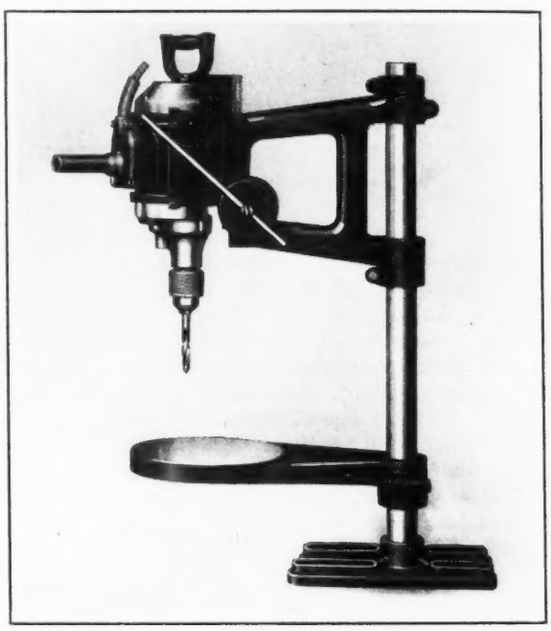


Three-speed Reducer Made by Gears & Forgings

HISEY RADIAL DRILLING STAND

A radial drilling stand with sensitive feed, which can be furnished for all Hisey portable electric drills up to and including the 7/8 inch size, has been designed by the Hisey-Wolf Machine Co., Cincinnati, Ohio. This stand, which is here illustrated, is equipped with a lever feed operated by a rack and pinion in the same manner as a drilling machine. This permits a positive and sensitive control without fatigue to the operator. The arm carrying the drill can be swung completely around the column.

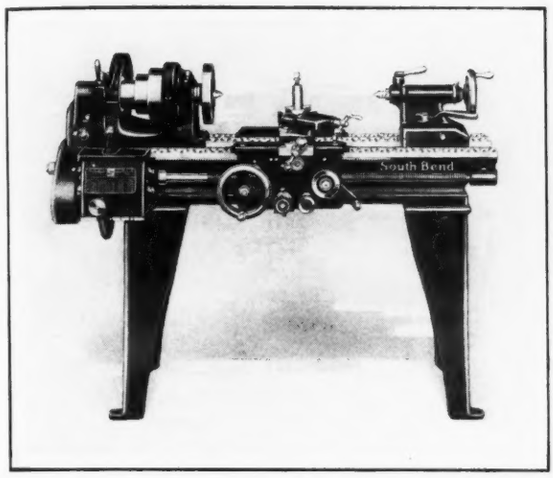
The motor-holding brackets are so designed that a portable drill can be attached without removing a single part of the machine. This feature guards against the loss of parts. Some of the important specifications of the stand are as follows: Vertical adjustment by means of the lever feed, 7 1/2 inches; vertical adjustment up and down on the main column, 13 inches; total vertical adjustment, 20 1/2 inches; maximum arm reach from column to drill spindle, 13 inches; and weight, approximately 150 pounds.



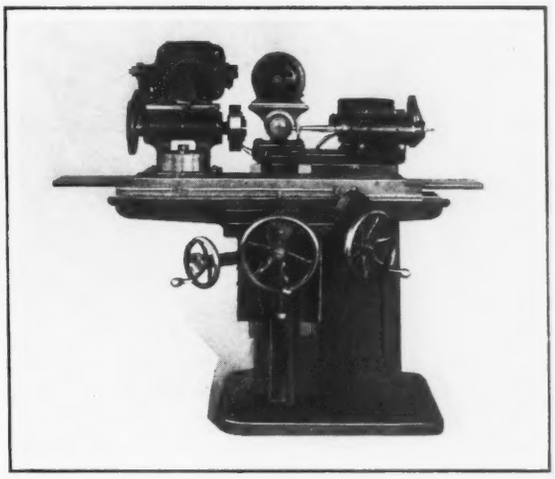
Hisey Radial Drilling Stand with Sensitive Feed

SOUTH BEND IMPROVED LATHE

The principal improvement in a 9-inch lathe being introduced on the market by the South Bend Lathe Works, 770 E. Madison St., South Bend, Ind., is a new headstock of the same design as that recently adopted on the large-sized new model tool-room lathes built by this concern. The new headstock has a three-step cone pulley which delivers 25 per cent more power than the headstock of earlier models. The headstock casting is strengthened and braced by improved gear guards, as on the new 16-inch model. These gear guards, together with a new means of se-



South Bend 9-inch Lathe with New Headstock and Other Improvements



Jarecki Grinding Machine Fitted with Internal and Face Grinding Spindles

curing the headstock to the bed, insure permanent alignment of the headstock spindle.

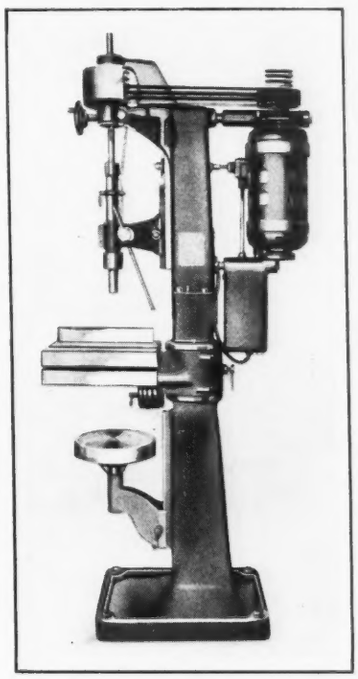
The lathe is intended for service in the manufacturing plant, tool-room, machine shop, service shop, and engineering laboratory. In the automotive field, it is especially suitable for such operations as refacing valves, reboring connecting-rods, finishing pistons, and making bushings. Elsewhere it is suitable for producing machine parts and for fine gage, tap, die, and instrument work.

AVEY DRILLING MACHINE WITH "TEXROPE" DRIVE

A sensitive drilling machine equipped with a new type of drive has been designed by the Avey Drilling Machine Co., Inc., Cincinnati, Ohio. The drive consists of a four-speed constant-horsepower double-fan ventilated motor which is adjustably mounted on the back of the column. It drives the spindle through "Texropes." Two sets of sheaves provide a high and low range of speeds, eight in all. This arrangement is particularly desirable in the tool-room or wherever a large variety of work is to be handled on the machine. The motor speeds are instantly changed by means of a lever at the front of the column. Overload and low-voltage protection are furnished.

JARECKI INTERNAL GRINDING MACHINE

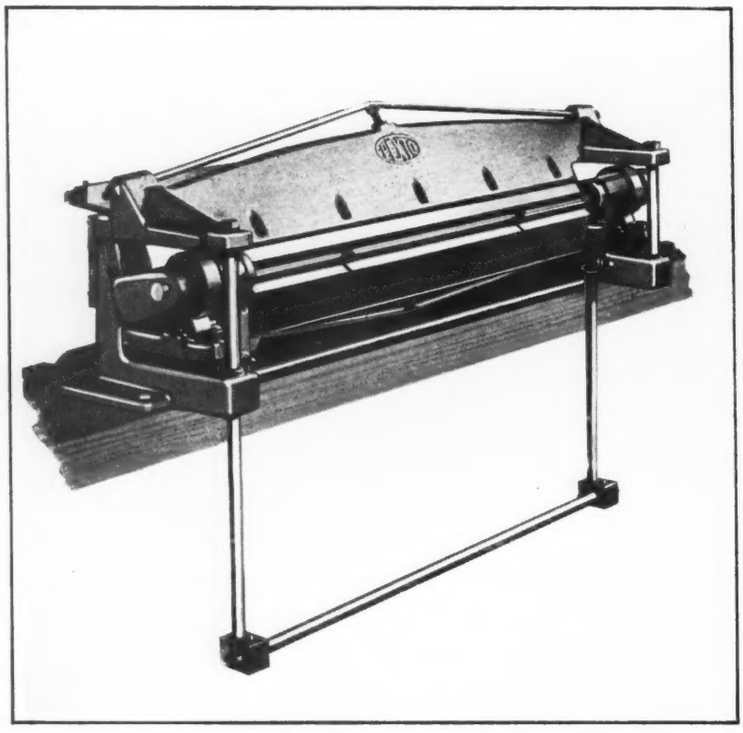
A grinding machine equipped with a heavy-duty internal grinding spindle, a high-speed internal grinding spindle, and a heavy-duty face grinding spindle is being placed on the market by the Jarecki Machine & Tool Co., Hall St. and Steele Ave., S. W., Grand Rapids, Mich. All three of these spindles are of self-aligning ball-bearing construction. The work may be held in the jaws of a 7 1/2-inch chuck or clamped to a faceplate. The chuck spindle is also of self-aligning ball-bearing construction. The head can be set at any desired angle.



Avey Sensitive Drilling Machine with New Type of Drive

Individual motor drives are furnished for the internal grinding attachment, the face grinding attachment, and the head, so as to control the different speeds. Speeds ranging from 2600 to 5200 revolutions per minute are available for the heavy-duty internal grinding spindle; speeds from 10,000 to 15,000 revolutions per minute, for the high-speed internal grinding spindle; and a speed of 5600 revolutions per minute, for the face-grinding spindle. The chuck spindle can be run at speeds ranging from 80 to 240 revolutions per minute.

Holes from 1/4 inch in diameter by 4 inches in length up to 10 inches in diameter by 10 inches in length, and faces up to 12 inches in diameter, can be ground. While the machine is regularly equipped with a hand feed, it can also be furnished with a power feed. Important specifications of the machine are as follows: Vertical movement of table, 12 inches; longitudinal movement of table, 24 inches; transverse movement of table, 10 inches; and weight of machine complete, 2400 pounds. The chuck is driven by a 1/4-horsepower motor and the grinding spindles by 1/2-horsepower motors.



"Pexto" Folder with Clamp which Grips Work Automatically when the Bending Leaf is Raised

"PEXTO" BRAKE AND FOLDER

The No. 64 "single motion" utility brake and folder recently placed on the market by the Peck, Stow & Wilcox Co., Southington, Conn., has been designed to automatically clamp the sheet to be folded when the bending leaf is raised in the usual manner for forming the lock or angle. This folder has a capacity for forming locks ranging from 3/16 inch wide on No. 24-gage soft steel up to 1/2 inch wide on No. 18-gage stock. It is intended for regular and nested pipe work, and will accommodate sheets up to 30 inches in width.

This folder is built on the brake principle with the jaws open from front to back. Folding blades and inserts can be interchanged for forming "Acme" and "Security" nested stove pipe locks. Facilities for gaging are provided on the bending leaf as well as at the rear of the machine. The bending leaf has a handle bar which can be adjusted for short or long leverage. Floor legs are available if required.

JOHNSON SELF-LUBRICATING BEARING

A new self-lubricating bronze bearing has been brought out by the Johnson Bronze Co., New Castle, Pa. A uniform distribution of bearing pressure and of lubricating compound are the objects of this new development. The bearing is especially valuable for machinery and parts subjected to intermittent or periodical operation, such as brake levers, clutch levers, shock absorbers, rocker arms, slow-running journals, starting motors, guide rollers, sliding door rollers, and similar applications.

"MIKROTAST" LEAD AND WIRE TESTERS

For checking the lead of taps, the Coats Machine Tool Co., Inc., 110-112 W. 40th St., New York City, is introducing on the American market a test bench arranged as shown in Fig. 1, with a special "Mikrotast" fixture. The latter can be employed by itself, for testing the lead of thread gages. The master tap is held between centers and the "Mikrotast" fixture is so placed that the bars at the back of the fixture square up with slidable flats on the back of the indicator. The contact jaw on the right is equipped with a micrometer adjustment, while that on the left operates the indicator. By setting the indicator hand to the zero mark and also setting the red plus and minus tolerance markers, duplicate taps can be easily checked for inaccuracies in lead, as compared with the master tap.

Fig. 2 shows a "Mikrotast" tester for measuring fine wire accurately without exerting the least pressure. This fixture is particularly useful in instances where wire would be deformed under the pressure of micrometer screws or could not be gaged

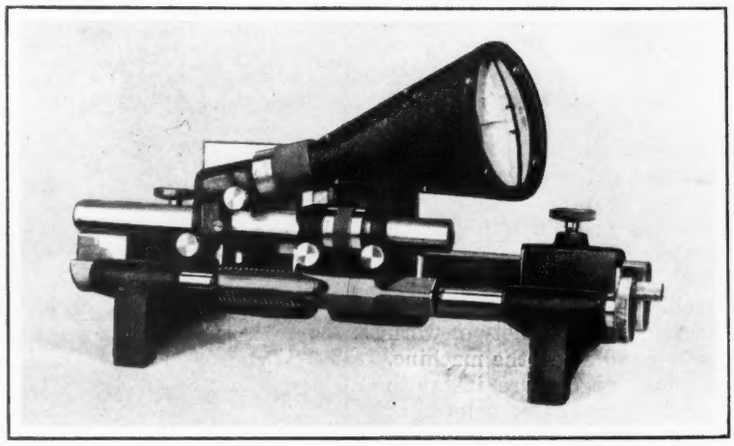


Fig. 1. Test Bench Fitted with "Mikrotast" Indicator for Inspecting the Lead of Taps

with sufficient accuracy. The supporting anvil is insulated and connected with a dry cell placed on top of the column. Another terminal leads to a red light bulb located directly over the "Mikrotast" scale. In using this instrument, the bulb lights up whenever the wire being measured is too large. The particular instrument shown has a range of 0.0025 inch.

ASHLAND AIR-OPERATED DRILLING MACHINE VISE

An air-operated vise designed to speed up the operation of drilling machines by reducing the time required for setting up the work is being placed on the market by the Ashland Machine Tool Co., 549 W. Washington St., Chicago, Ill. This vise is made in three sizes, with work-holding capacities of 2500, 5000, and 10,000 pounds, respectively, at an air pressure of 80 pounds per square inch.

While primarily intended for production drilling operations, the vise is also applicable to milling machines. It consists of a base designed to be bolted to the table of the machine. In a housing at the rear of the base there is an air cylinder which actuates two opposed jaws. Above the cylinder there is a so-called "jig-fixture" plate for carrying secondary work-holding or locating fixtures that may be necessary to assist the jaws in holding the work or to locate holes to be drilled.

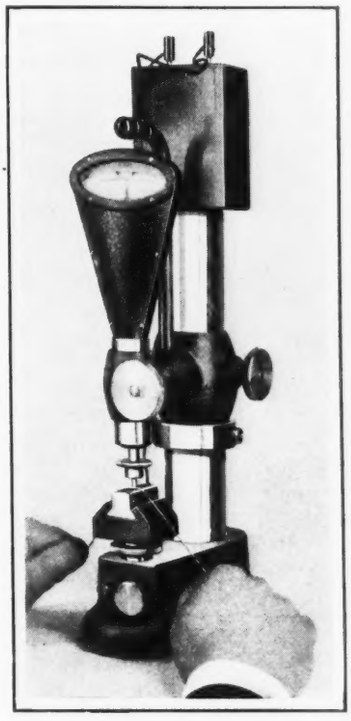


Fig. 2. "Mikrotast" Device for Measuring Fine Wire

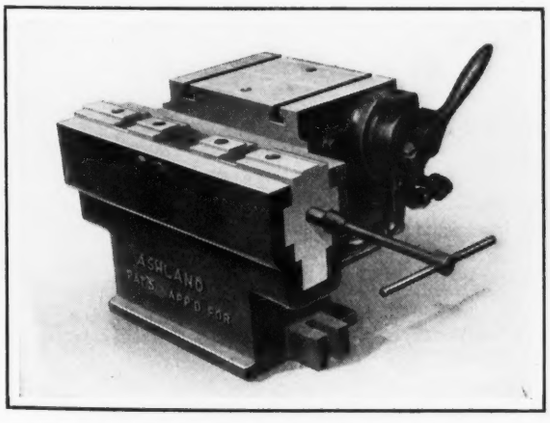
Each jaw has a finished tongue and cross-groove and two tapped holes. Thus, whatever type of special formed jaw may be required for holding work can easily be mounted on the jaws. Between the jaws there is a dowel hole that is fitted with a hardened bushing. This hole facilitates lining up the fixture with the spindle of the drilling machine.

The jig-fixture plate does not interfere with the handling of work requiring the use of clamping jaws only. This plate is furnished with T-slots and two dowel-pin holes fitted with hardened bushings. There are also graduation lines on the plate. This combination of facilities makes it easy to locate and secure in place any type of secondary fixture required.

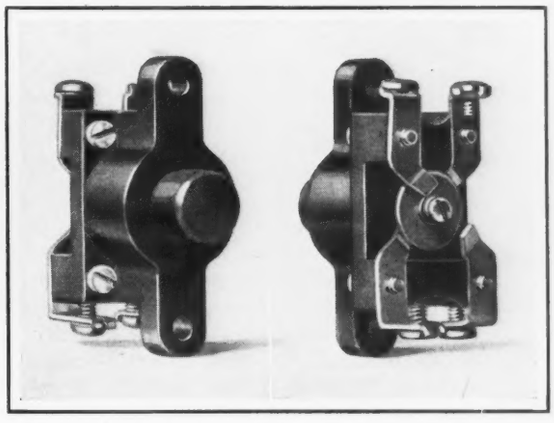
The valve that tightens or releases the jaws may be operated by hand or by a foot-treadle. On the vise illustrated, which is of the size developing a pressure of 5000 pounds, the jaws have a movement of 2 inches, one inch for each. Obviously, it is necessary to set the jaws in approximately the proper positions to suit the work. This is accomplished by applying a socket wrench to a right- and left-hand screw threaded into the jaws. The maximum adjustment is 6 inches, and the maximum distance over the ends of the jaws, 22 inches.

WESTINGHOUSE PUSH-BUTTON UNITS

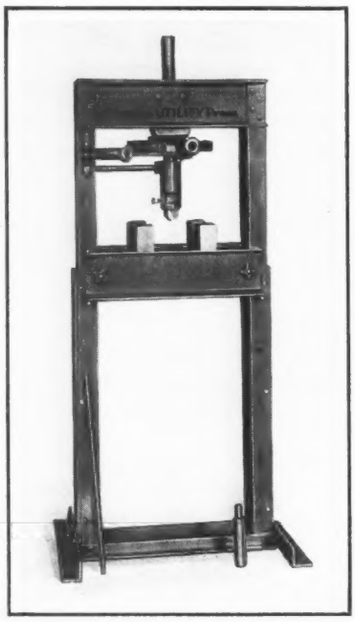
A new push-button unit recently brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for use on machine tools, elevators, conveyors, and other applications where a built-in control station is desired is shown in the illustration. Among the advantages claimed are neat appearance, compactness, ease of mounting, flexibility of arrangement, and saving of time in wiring. The units are



Ashland Air-operated Vise Designed Primarily for Drilling Machines



Front and Rear Views of Westinghouse Push-button Unit for Built-in Applications



Simplex "Utility" Press

so designed that they may be conveniently grouped on control stations. Wiring is facilitated, as the units can be mounted directly on a cover plate. The frame is made of black Micarta and the operating button can be either black or red.

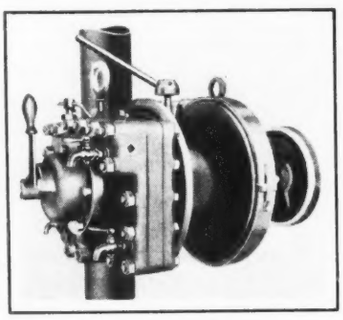
SIMPLEX "UTILITY" PRESS

Pressures up to 80,000 pounds are obtainable on a "Utility" press recently designed by the Simplex Tool Co., Woonsocket, R. I., for use in the tool-room and machine shop. Tool-room applications include the shearing of soft punches in hardened dies and the trying out of forming, blanking, piercing, and bending dies. The press may also be used for making stops or supports that extend from dies where the pieces are longer than the width of the dies, for pressing posts in dies, and for other assembly work where a press fit is required. Steel bars 1/2 inch thick by 4 inches wide can be bent cold up to an angle of 90 degrees.

In the machine shop, the press is suitable for various bending, straightening, pressing-in, and pushing-out operations. Three different leverages of different speeds and power are available. The ratchet wheel is mounted on ball bearings for ease in spinning the plunger to and from the work. The over-all height of the press is 60 inches, and the width between the frame uprights is 21 inches.

GARDNER-DENVER AIR OR STEAM HOISTS

Two models of single-drum air or steam hoists are being placed on the market by the Gardner-Denver Co., Quincy, Ill. The outstanding features of these No. 8 and No. 10 models are an improved engine design, with balanced pistons and an air control through balanced spool valves having increased port areas throughout to give greater efficiency and the same speed both



Gardner-Denver Hoist for Air or Steam

forward and reverse. All moving parts of the hoists are fully enclosed. The Model 8 hoist is rated at 6 horsepower, with a rope pull of 2000 pounds at a speed of 150 feet per minute. The drum is 6 inches in diameter by 9 1/4 inches wide, and has a capacity for 620 feet of 3/8-inch rope.

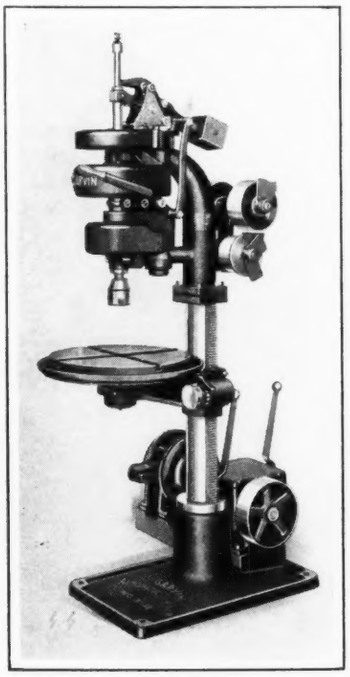
GARVIN HEAVY-DUTY TAPPING MACHINE

The No. 3-B heavy-duty automatic tapping machine of the Garvin line built by the Western Machine Tool Works, Holland, Mich., was designed to take care of large-sized taps. It will drive U. S. standard taps of from 1 to 1 3/4 inches in cast iron and 1 to 1 1/2 inches in steel and pipe taps up to 1 1/4 inches in cast iron and to 1 inch in steel.

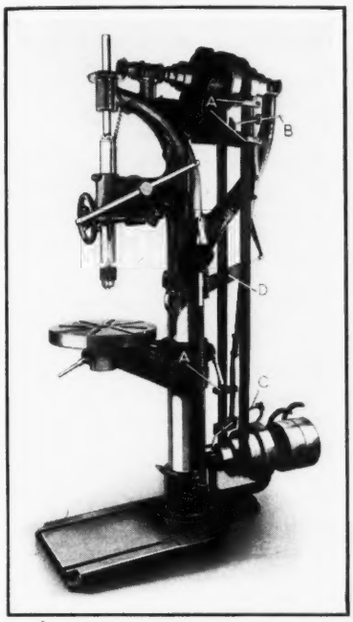
The machine is equipped throughout with Timken tapered roller bearings, and may be provided with a four-speed change-box, as illustrated. This speed-box may be arranged for a motor drive, as shown, or for a single-pulley drive. The speed-box is also equipped throughout with Timken bearings.

In operation, the hand-lever is pulled down or the foot-treadle depressed until the tap enters the work. From then on, the action is automatic, the tap entering to a predetermined depth and then automatically reversing. The spindle is so arranged and balanced that it will not cramp, and hence withdraws taps without stripping the last thread.

The depth tapped is regulated by means of a trip located at the top of the spindle. This trip can be adjusted to within the close limits necessary where blind holes are being tapped. As the proper depth is reached, the trip strikes a lever which releases the clutch in the upper pulley and engages the clutch in the lower pulley, thus reversing the direction of tap rotation and drawing the tap out of the work. Holes up to 2 1/2 inches deep can be



Garvin Tapping Machine for Large-size Taps



U. S. Cone-pulley Belt Shifter for Drilling Machines

tapped. The distance from the center of the spindle to the column is 12 1/2 inches; the spindle has a movement of 4 inches; and the table can be adjusted vertically 20 inches. The net weight of the machine is 1175 pounds.

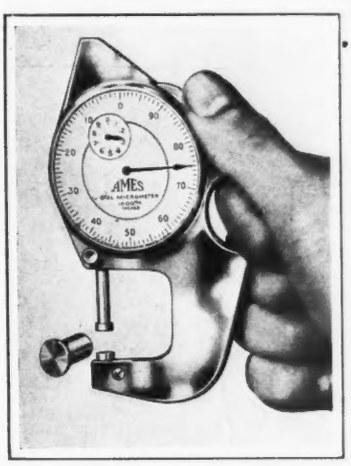
U. S. CONE-PULLEY BELT SHIFTER

A cone-pulley belt shifting device intended primarily for application to upright drilling machines has been brought out by the United States Tool & Machine Works, 27 Thames St., New York City. Effective operation is said to be insured through the use of two "loops" *A* at each cone pulley which, as they shift the belt from a higher to a lower step or vice versa, hold one side of the belt at right angles to the pulley axis. These loops are fastened a proper distance apart on the shifter rod and are guided, in the operation of shifting the belt, by rods *B* and *C*.

The shifter rod is actuated by moving arm *D* in the direction in which the belt is to be shifted. There are notches in the under side of this arm which engage a support piece to lock the belt on any desired steps of the pulleys. The opposite end of arm *D* is riveted to the shifter rod and is also connected to a pivot rod fastened to the column of the machine.

AMES DIAL MICROMETER

A dial micrometer designed for quickly and accurately determining the dimensions of parts is the latest addition to the line of products made by the B. C. Ames Co., Waltham, Mass. As may be seen from the illustration, this micrometer has a large dial with widely spaced graduations, each of which represents 0.001 inch. There is also a small dial which indicates the revolutions of the pointer on the large one. Each graduation on the small dial represents 0.1 inch.



Ames Dial Micrometer with Graduations to 0.001 Inch

The quick-acting spring-spindle is lifted by imparting a simple upward movement of the thumb to the knurled wheel. The micrometer closes itself in position on the work to be measured and shows the reading instantly on the face of the dial. Readings can be locked by pushing a button, thus permitting the micrometer to be used as a snap gage. The micrometer has a capacity of 1 inch.

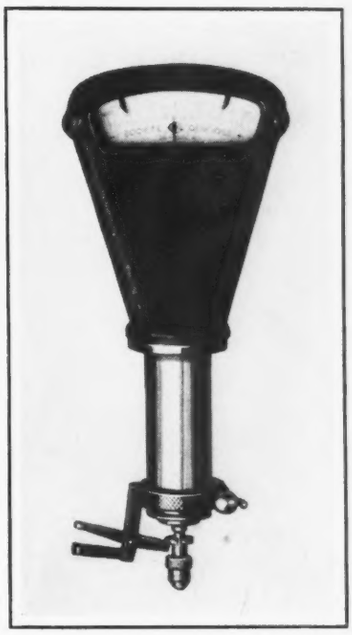
On the back of the dial there is a handy table of decimal equivalents which facilitates the conversion of readings into fractions of an inch.

MICRO-INDICATOR TUBE FOR PRECISION COMPARISONS

The Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, has brought out a new form of micro-indicator tube for use with the various types of supports made by the concern for accurately checking parts by comparison with standard gages or gage-blocks. The R. Y. Ferner Co., Investment Building, Washington, D. C., is the American agent. This new tube has a fan-shaped dial that gives a range two and one-half times that of a cylindrical indicator.

The tube embodies a knife-edge multiplication system of such a construction that the knife-edges are separated when the plunger is raised, and, therefore, instead of motion being transmitted to the lower knife-edge, the knife-edges are relieved of the damaging effects of shocks on the contact plunger, which would otherwise dull them. The knife-edges must be very sharp to give a constant amplification throughout the whole travel of the pointer.

With the fan-shaped dial, an angular swing of the pointer of over 32 degrees is obtained,



Societe Genevoise Micro-indicator Tube

which makes it possible to use a more open scale as well as to have a greater range. With the multiplication system adjusted to a 400 to 1 ratio, two scales are used. One of these has sixty divisions, each of which is about 0.04 inch wide and represents 0.0001 inch so that the range of the scale is 0.006 inch. The other scale has thirty divisions twice as wide as those of the first, each of which represents 0.0002 inch. With a multiplication of 120 to 1, a third scale is used having forty divisions, each of which is 0.06 inch wide and represents 0.0005 inch, thus giving a range of 0.02 inch.

Two red-colored tolerance indices are adjustably mounted in a slot above the dial. With these tolerance marks set at the upper and lower limits for any part being measured, the indicator can be used for the rapid inspection of parts with precision. The contact plunger at the lower end of the indicator has a hard flat anvil surface. Other types of anvils can be readily slipped over it. One of these is a new type of spherical contact point consisting of a hard steel ball which can be adjusted into new positions as it becomes flattened from wear, or replaced.

"VULCAN SUPERIOR" TONGS FOR PIPE AND FITTINGS

Double service is rendered by the "Vulcan Superior" chain tongs which have been placed on the market by J. H. Williams & Co., Buffalo, N. Y., for universal service on both pipe and fittings, since two tools are commonly

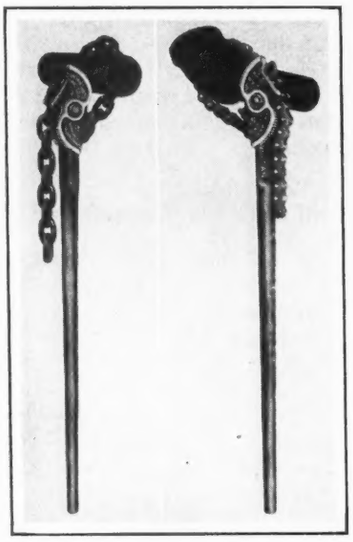


Fig. 1. "Vulcan Superior" Tongs for Pipe and Fittings

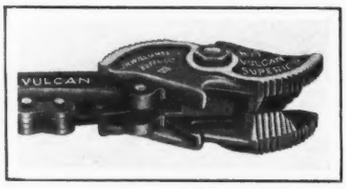


Fig. 2. Illustration Showing V-recess in the Reversible Jaw

used on such parts. As shown in the illustration, these tongs are made with either cable or flat chain.

One of the principal features is a V-recess in the jaws which insures a quick and positive grip on fittings. This recess is illustrated in Fig. 2. No changes in the tongs are necessary for applying them to both pipe and fittings. Another feature of the tongs is that the jaws are reversible. When the teeth wear, the jaws are simply turned end for end to double the life of the tongs. All parts are interchangeable.

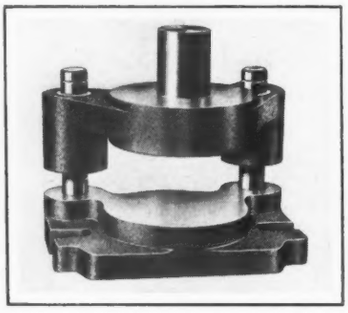
These tongs are made in seven sizes to cover fittings from 1/8 to 12 inches. Their weights range from 1 3/4 to 55 pounds, and their lengths, from 13 3/4 to 64 1/2 inches.

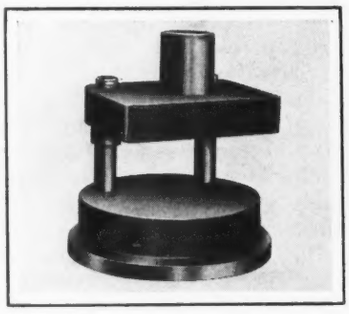
PRODUCTO DIE SETS FOR POWER PRESSES

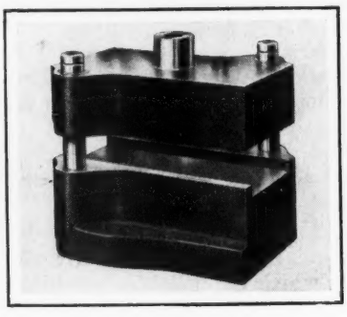
Recent additions to the line of standardized power press die sets manufactured by the Producto Machine Co., Bridgeport, Conn., are shown in the accompanying illustrations. The punch- and die-holders of these sets may be semi-steel or steel castings or they may be cast from a chrome-nickel iron mixture having from 40 to 50 per cent of steel scrap. These parts may also be hammered steel forgings.

Fig. 1 shows the Style 146 round die set which has been designed to meet ordinary requirements in the production of round stampings. The guide pins are located at the rear where they are out of the way. This die set is made in ten different sizes, the circular portion of the punch- and die-holders ranging from 4 to 15 inches in diameter. Square punch-holders and a corresponding square die-holder can also be furnished for this set.

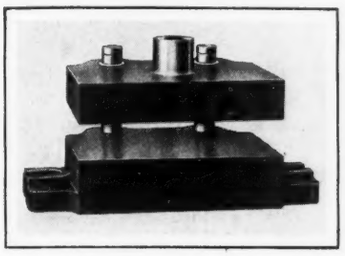
Another round die set, known as the Style 147, is similar to the Style 146, with the exception that the guide pins are placed on center. This set can be used on operations where strips of metal are to be passed between the guide pins, which are in line with the operator. This die set

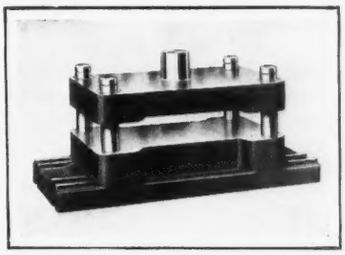


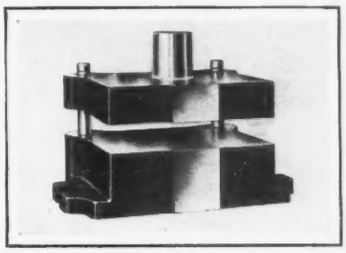




Figs. 1, 2, and 3. Three Styles of Power Press Die Sets Recently Added to the Standardized Line of the Producto Machine Co.







Figs. 4, 5, and 6. Three More Producto Die Sets, Two of which are Especially Designed for Henry & Wright Dieing Machines

can also be used with the open sides toward the operator for cupping and piercing operations.

Fig. 2 shows another round die set, Style 130, of compact design, for use on power presses where the shut height is limited or the working surface of the bolster plate is small. The clamping surface of the die-shoe is finished around the whole circumference to permit easy clamping in any position. This die set is regularly furnished with guide pins having concentric grooves, but pins with spiral grooves can also be supplied. Six sizes of this die set are made, with die-shoe working surface diameters ranging from 4 to 12 inches.

Fig. 6 shows an overhanging type of die set, designed to take extra wide metal stock, the distance from the front to the rear being longer than the distance from right to left. This set is made in Styles 141 and 149 differing only in the thickness of the punch- and die-holders and the maximum dimension across these parts when open. Ten sizes of this die set are made, the width across the finished working surface of the punch- and die-holders ranging from 3 to 12 inches.

Standard die sets designed for use on Henry & Wright dieing machines are shown in Figs. 3, 4, and 5. These sets have been so designed that they can be passed between the guide rods of the machine without removing the head of the machine. Other types of die sets are also made for these machines to provide extra large working surfaces, but the head must be removed to mount them on the bolster.

Fig. 4 shows the Style 176 die set which has two guide pins at the rear. It is intended for the 10- and 25-ton dieing machines and is made in two sizes, in which the width of the punch- and die-holder work surfaces is 6 and 9 inches, respectively. Style 177, illustrated in Fig. 3, has the guide pins located diagonally and is designed for use on the 25- and 50-ton machines. The design provides an extra large working surface and at the same time allows easy mounting of the set between the guide rods of the machine. This set is also made in two sizes, with widths of 9 3/4 and 16 inches, respectively.

The Style 178 die set, illustrated in Fig. 5, is fitted with four guide pins and is intended for application on the 25- and 50-ton machines. This set provides maximum die space in relation to the total width of the set. Two sizes are made, with work surface widths of 11 1/2 and 16 inches, respectively.

ETTCO HAND-OPERATED DRILL CHUCK

Positive hand operation is the main feature of a chuck recently placed on the market by the Ettco Tool Co., Inc., 590 Johnson Ave., Brooklyn, N. Y., for application to portable electric and pneumatic drills. In placing a drill in the chuck, it is only necessary to tighten the chuck enough to permit the jaws to take hold when the drilling operation is started. The gripping of the tool is accomplished automatically. To release the tool, the grooved outer sleeve is merely struck a quick glancing blow with the palm of the hand.

From the combined sectional and phantom view, Fig. 2, it will be seen that the chuck has three jaws which are a sliding fit in a bored nose that screws into the chuck sleeve. The jaws are attached to a ball-bearing thrust assembly which screws up or down along the threads of the

Fig. 1. Ettco Hand-operated Chuck for Portable Drills

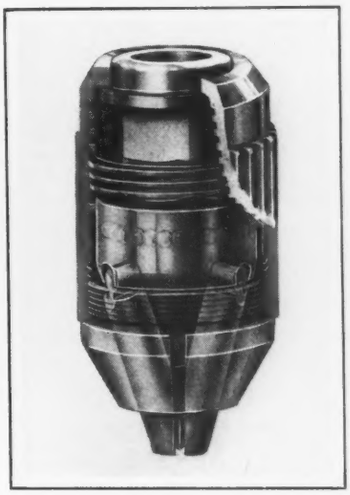


Fig. 2. View Showing Details of the Chuck Construction

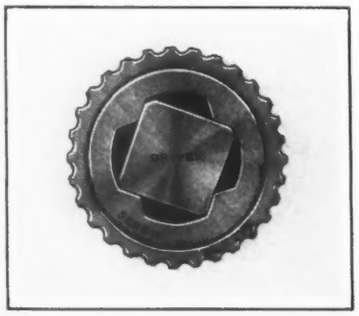


Fig. 3. Sectional View Illustrating the Fit of the Driver and Thrust-assembly Screw

chuck sleeve at the opposite end from the nose. All these parts are mounted on and revolve around a driver that is fastened to the spindle of the portable drill on which the chuck is to be used.

The square section of the driver fits loosely into the screw of the thrust assembly. By turning the body of the chuck about the driver and this screw, the thrust assembly is caused to travel up or down and the jaws to open or close.

After a tool has been gripped in the chuck, the body or sleeve of the chuck and the screw of the thrust assembly can be oscillated about the driver within the limits of the square stops seen in Fig. 3. If the chuck is suddenly rotated in the same direction as that in which it is driven, a knock or blow is imparted which causes the screw to release from its binding friction in the threaded sleeve. Thus, in order to release a drill, the chuck is drawn back to bring the square stops on the other side of the driver, and then a quick blow is given with the palm of the hand, as previously explained.

The outer parts of the chuck are made from a 0.40 per cent carbon high-manganese steel, while the inner parts are made from a 0.20 per cent carbon high-manganese steel, carburized and hardened. The jaws are made from an oil-hardening alloy steel. The chuck is made in two sizes at present, having an actual capacity of 9/32 and 21/64 inch, respectively.

"THOR" ROTARY AIR GRINDERS

A new line of pneumatic grinders based on the rotary principle has been developed by the Independent Pneumatic Tool Co., 606 W. Jackson Blvd., Chicago, Ill. The principal advantages claimed are light weight, governed speed, increased power, lack of vibration, low air consumption, and minimum upkeep cost.

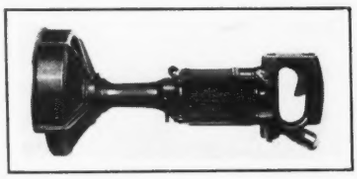
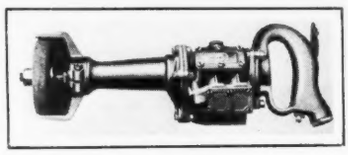


Fig. 1. "Thor" Rotary Air Grinder which Runs at a Speed of 4300 Revolutions per Minute

The line ranges from grinders having a speed of 28,000 revolutions per minute to those having a speed of 4300 revolutions per minute. Fig. 1 shows the No. 260G grinder, which runs at 4300 revolutions per minute and carries an 8-inch elastic bonded wheel or a 6-inch vitrified wheel. Its weight is 13 1/2 pounds. The No. 00 grinder, illustrated in Fig. 2, has a speed of 28,000 revolutions per minute and is particularly adapted for touching up dies and similar work. It carries a 1 1/4-inch elastic bonded wheel and various grinding pencils, sticks, etc. The weight is 2 3/4 pounds.

"LITTLE GIANT" PNEUMATIC GRINDER AND BUFFER

The No. 10-A "Little Giant" pneumatic grinder and buffer made by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City, is now equipped with the closed type of pistol grip throttle handle shown in the illustration, instead of with the open type. It can also be furnished with a straight type of throttle handle as optional equipment. This grinder is intended for general light work, including the smoothing of flush-head rivets. It has a wheel capacity of 4 by 3/4 inch. The speed is 4400 revolutions per minute; the overall length is 16 1/2 inches; and the net weight of the tool is 8 1/4 pounds.



"Little Giant" Pneumatic Grinder and Buffer

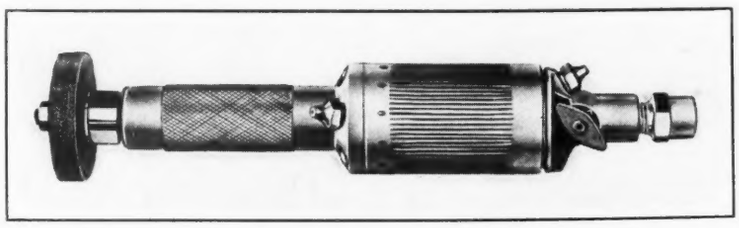


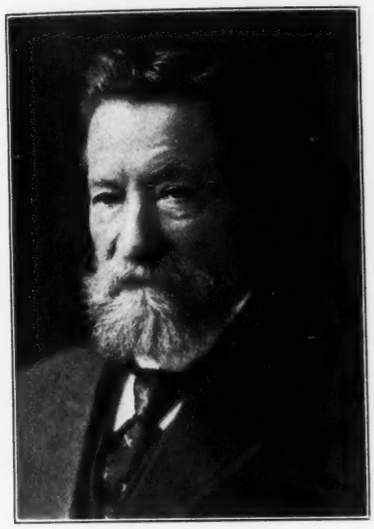
Fig. 2. Rotary Air Grinder for Touching up Dies, which Runs at 28,000 Revolutions per Minute

THE STEEL INDUSTRY IN RUSSIA

According to a recent number of *Freyn Design*, a publication issued by the Freyn Engineering Co., Chicago, Ill., a group of engineers of this company are investigating the steel industry of the Soviet Union with a view to making suggestions for a thorough modernization of the iron and steel works in Russia. Plans are being made for the rehabilitation and enlargement of several plants.

HUGO BILGRAM CELEBRATES EIGHTY-THIRD BIRTHDAY

On January 13, Hugo Bilgram, president of the Bilgram Machine Works, Inc., Philadelphia, Pa., pioneer manufacturer of gear-cutting machinery, celebrated the eighty-third anniversary of his birth. Mr. Bilgram was born in Memmingen, Bavaria, Germany, in 1847. He graduated from the Polytechnic School of Augsburg, Germany, in 1865.



Hugo Bilgram

For four years he was employed at several works in Germany as a machinist and draftsman, and on January 29, 1869, he arrived in the United States, coming direct to Philadelphia where he has lived ever since.

Mr. Bilgram was first employed by the L. B. Flanders Co. Later he became an instrument maker with Joseph Zentmayer and soon afterward machine designer with the Southwark Foundry & Machine Co. In 1876 he became assistant to Henry Petit, chief engineer and chairman of the Jury of Awards at the Centennial Exhibition in Philadelphia. At the close of the exhibition he entered the employ of the Brehmer Bros. Co., first as an expert machinist and later as foreman. When the Brehmer Brothers decided to remove their plant to Germany, Mr. Bilgram was placed in charge of the American branch as a partner. In March, 1879, he became the sole owner of the plant, which was incorporated under the present name—the Bilgram Machine Works, Inc.

It was in 1883 that Mr. Bilgram built his first bevel gear generator, which became known throughout the world. In recognition of the development of this machine, he received the Elliott Cresson gold medal from the Franklin Institute. He also devoted his skill as an engineer to the designing and building of cigarette machines, developing equipment that worked wholly automatically for high-production purposes. In his earlier experience he devoted himself to improvements in steam engine economy, and in 1875 found a method of modifying the then generally accepted slide valve diagram, and by redesigning slide valve motions for steam engines he developed a new application of reversible and variable expansion slide valve gears. His work in this connection was later published in book form.

Outside of his engineering work, Mr. Bilgram has given much attention to microscopy and has also made a thorough study of the subject of economics. In 1889, he published a treatise on "Involuntary Idleness," and in 1914, he wrote, in collaboration with Louis Edward Levy, the "Cause of Business Depressions."

* * *

PERSONALS

TINIUS OLSEN, president of the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., has resigned and is succeeded by the vice-president, THORSTEN Y. OLSEN.

JOHN YOUNGER, professor of industrial engineering, Ohio State University, Columbus, Ohio, has been elected a vice-president of the Society of Automotive Engineers for 1930.

BRUCE G. LEIGHTON, director of sales and service, Wright Aeronautical Corporation, Paterson, N. J., has been elected a vice-president of the Society of Automotive Engineers for 1930.

H. K. PORTER has been appointed general sales manager of the Hyatt Roller Bearing Co., Newark, N. J., succeeding H. O. K. MEISTER, who was recently made assistant general manager of the company.

ERWIN E. DREESE, chief engineer of the Lincoln Electric Co., Cleveland, Ohio, has been appointed professor of electrical engineering at the Ohio State University. Mr. Dreese is a graduate of the University of Michigan, where he received the degree of electrical engineering in 1920. After graduation, he became instructor of electrical engineering at the university, and in 1924 was awarded the degree of Master of Science.

Erwin E. Dreese

A year after joining the Lincoln Electric Co., where he has been employed for the last five years, he was made chief engineer. In June, 1929, he was recalled to the University of Michigan to receive the professional doctor's degree of electrical engineering, a distinction said to have been conferred only once previously by that institution.

L. E. FRIES has been made Cincinnati district manager of the United States Electrical Tool Co., Cincinnati, Ohio,

L. E. Fries

succeeding R. H. CLORE, who was recently appointed general sales manager. Mr. Fries has had twelve years' experience in the automotive parts field.

EDWARD P. WARNER has been elected president of the Society of Automotive Engineers for 1930. Mr. Warner was formerly Assistant Secretary of the Navy for Aeronautics, and is now editor of the publication *Aviation*.

R. G. WELLS, assistant chief engineer of the Trundle Engineering Co., Cleveland, Ohio, has been made chief engineer, succeeding Mr. EICKHOFF. PAUL VAN SITTERT will take Mr. Wells' place as assistant chief engineer.

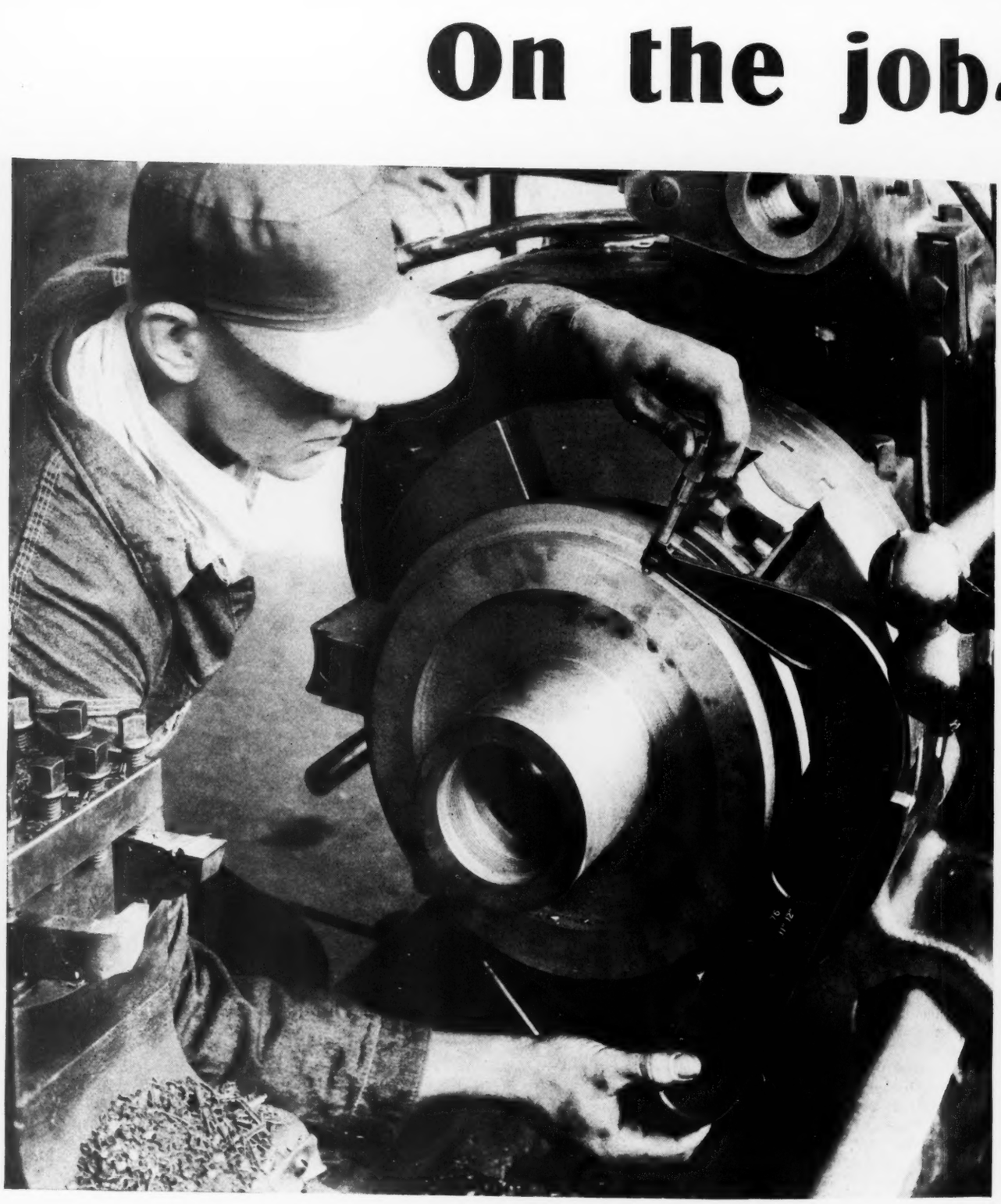
ALLEN E. CHESTER, formerly research engineer with the Union Oil Co. of California, has joined the sales staff of the Watson-Stillman Co., 73 West St., New York City. Mr. Chester will be located in the New York office.

E. F. MARRESFORD, formerly with the American Machine & Foundry Co., has become a member of the sales staff of the Watson-Stillman Co., 73 West St., New York City. He will devote his energy to contract machine work.

J. E. N. HUME has been appointed assistant manager of the Industrial Department of the General Electric Co., Schenectady, N. Y., and has been succeeded by C. F. PITTMAN as manager of the motor division of the department.

E. R. WEBER, formerly assistant chief engineer of the R. D. Nuttall Division of the Westinghouse Electric & Mfg. Co., has become chief engineer of the

On the job—G



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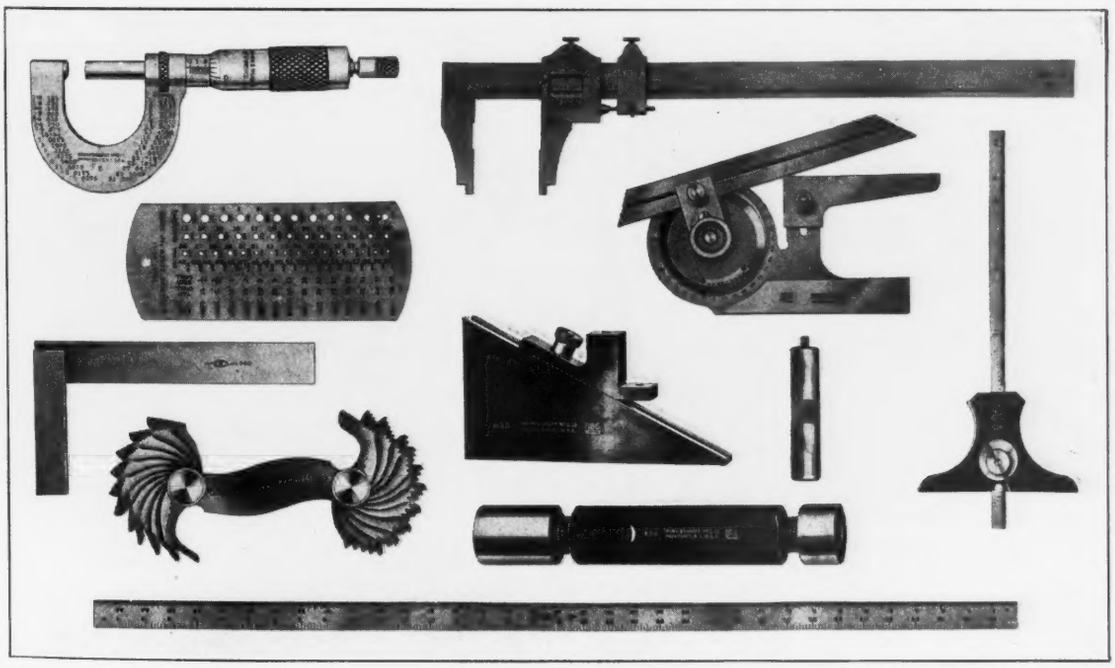
Good Tools Save Time

On the job, Brown & Sharpe Tools constantly demonstrate their usefulness and economy. Their design makes them handy to use and cuts down the time required for checking and set-ups. Their reliable accuracy reduces spoilage due to imperfect measurements. Brown & Sharpe Tools are the most economical tool investment you can make and their use will produce substantial savings in the year's manufacturing costs. Use Small Tool Catalog No. 31 for your buying guide. Copy sent on request. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.



& Sharpe Tools

"World's Standard of Accuracy"

Thomas Spacing Machine Co., Pittsburgh, Pa., manufacturer of structural and bridge machinery.

STUART M. CROCKER, who on January 1 resigned his position as vice-president and treasurer of the United Electric Securities Co. to become assistant to the president of the International General Electric Co., has been elected a vice-president of the latter company.

C. A. PRIEST has been made designing engineer of radio transmitters in the radio transmitter department of the General Electric Co., Schenectady, N. Y. Mr. Priest succeeds B. R. CUMMINGS, who has joined the newly organized Radio Victor Corporation as a division engineer on transmitter work.

CHARLES E. WILSON, formerly assistant to the vice-president of the General Electric Co., at Bridgeport, Conn., has been made manager of the Merchandise Department. Mr. Wilson, who succeeds the late H. C. Houck as manager, will continue to have supervision of manufacturing, engineering, and sales activities of the department.

J. H. BELKNAP has been appointed manager of the control engineering department of the Westinghouse Electric & Mfg. Co., at East Pittsburgh, Pa. He succeeds E. B. NEWILL, who has left the Westinghouse organization to become assistant to the president of the Delco Products Co., a subsidiary of the General Motors Corporation. Mr. Belknap has been in the employ of the Westinghouse company since 1923.

FRANCIS G. ECHOLS has been elected president of the Greenfield Tap & Die Corporation, Greenfield, Mass., succeeding FREDERICK H. PAYNE, who will become chairman of the board of directors of the corporation. Mr. Echols was for many years manager of the Small Tool Division of the Pratt & Whitney Co., Hartford, Conn. Since 1919 he has been with the Greenfield Tap & Die Corporation in the capacity of vice-president and general manager.

HENRY M. SELSON of the Selson Engineering Co., Ltd., London, England, has come to the United States with a view to making additional agency arrangements with American manufacturers of machine tools and shop equipment. Mr. Selson is interested in new developments in the American machine tool industry. He expects to remain in this country until about February 15, and may be reached at the office of the Selson Engineering Co., 120 Liberty St., New York City.

L. WARRINGTON CHUBB, manager of the radio engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been made first assistant to the vice-president in charge of engineering of the new Radio-Victor Corporation of America, with headquarters in Camden, N. J. Mr. Chubb has been manager of the Westinghouse radio department since it was started in 1920. Before that, he was active in development and research work for the company.

WILLIAM CRANE BABBITT has been appointed field engineer for the Industrial Truck Association, 52 Vanderbilt Ave., New York City. Mr. Babbitt is a graduate of the University of Michigan, and has had ten years' experience in the management of industrial plants and in the trade association field. One of the principal purposes of the Association is to collect data concerning material handling methods in various industries, and Mr. Babbitt has been employed to conduct a series of field surveys on this subject.

EDWARD J. KEARNEY, secretary and treasurer of the Kearney & Trecker Corporation, Milwaukee, Wis., has been elected chairman of the Standardization Committee of the American Society of Mechanical Engineers. Mr. Kearney's long experience in the machine tool industry in which he has always held a prominent place, having at one time been president of the National Machine Tool Builders' Association, will prove of great value to the American Society of Mechanical Engineers in its standardization work.

T. W. FRECH, vice-president of the General Electric Co., Schenectady, N. Y., has been granted a year's leave of absence, effective January 1, to become president of the RCA Radiotron Co. G. C. OSBORN and W. T. L. COGGER have resigned from the General Electric Co. to become associated with the same company as vice-president in charge of sales and as vice-president in charge of manufacturing, respectively. J. E. KEWLEY has been appointed acting manager of the Incandescent Lamp Department, effective January 1. M. L. SLOAN has been appointed assistant manager of this department, and E. E. POTTER has been appointed general sales manager of the Edison Division of the Incandescent Lamp Department.

HARRY A. SCHWARTZ, manager of research of the National Malleable & Steel Castings Co., Cleveland, Ohio, has been selected to receive the John A. Penton Gold Medal of the American Foundrymen's Association for the year 1930. This award is made to Mr. Schwartz for his outstanding contributions to the foundry industry, and will be presented to him at the 1930 convention of the association to be held in Cleveland during the week of May 12. Mr. Schwartz is especially noted for his many contributions to the field of research on malleable iron. He has been very active in the American Foundrymen's Association for many years as a contributor of important papers and as a member and chairman of various committees. At present he is chairman of two important committees of the malleable division.

JOHN E. BARKLE has been appointed works manager of the South Philadelphia Works of the Westinghouse Electric & Mfg. Co. Mr. Barkle has been in the employ of the Westinghouse organization since 1901. For a number of years he occupied important positions in the manufacturing departments. In 1919, when the Westinghouse company delivered the first electric passenger locomotives to the Chicago, Milwaukee & St. Paul Railroad, Mr. Barkle was made service engineer with headquarters in Montana. In 1921 he became superintendent of all Westinghouse service shops throughout the country, and in 1923, assistant superintendent of the power department at the East Pittsburgh Works. In 1926 he was promoted to the position of superintendent of generating apparatus, which position he held until his recent appointment.

ROBERT M. DERBY has been elected a vice-president of the Niles-Bement-Pond Co., New York, in charge of the company's foreign business. The Niles-Bemet-Pond Co. handles abroad the products of the Niles Tool Works Co., the Pratt & Whitney Co., and the Niles Division of the Shepard-Niles Crane & Hoist Corporation. Mr. Derby has been with the Niles-Bement-Pond Co. during the greater part of his business career, beginning as an apprentice in its shops after receiving his engineering training at the Massachusetts Institute of Technology, class of 1901. He has traveled widely in the interests of the company, and has recently returned from a three months' foreign trip during which he visited almost every European country, including Russia.

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NEW OFFICERS OF AMERICAN ENGINEERING COUNCIL

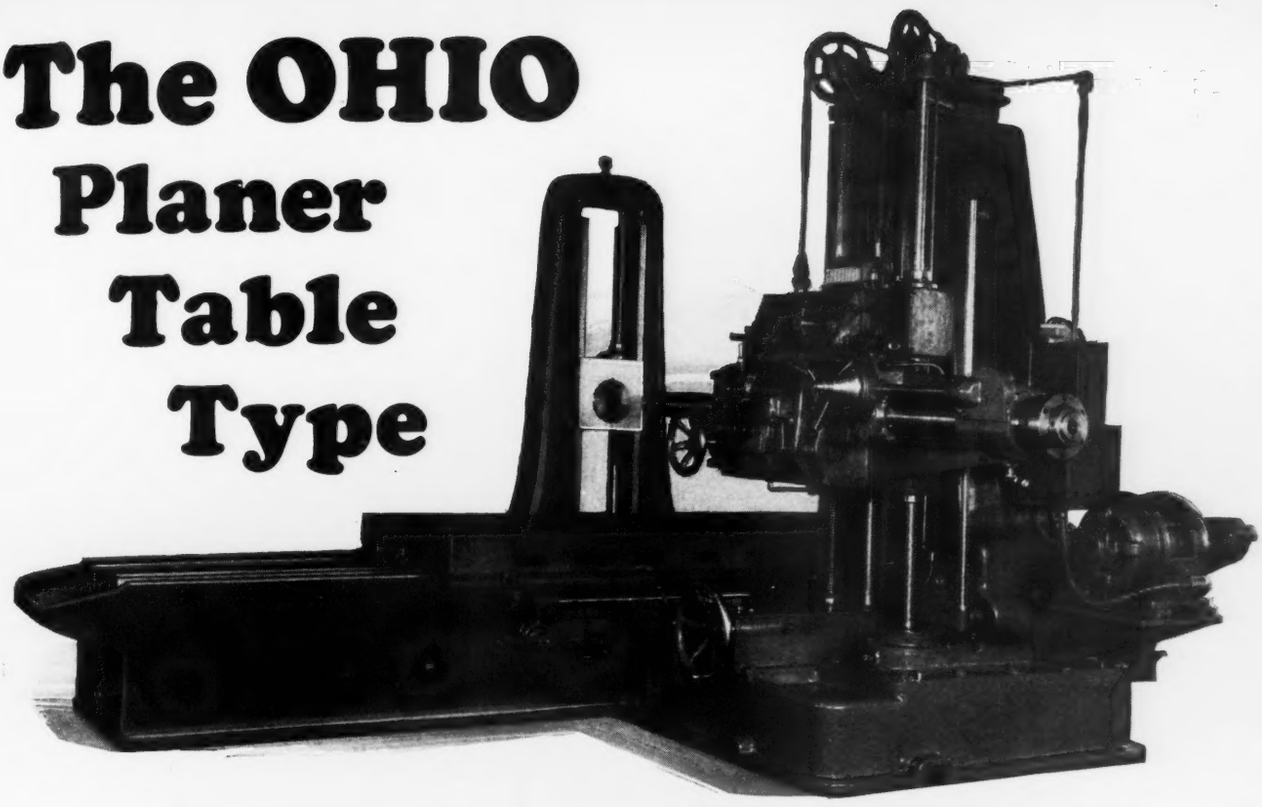
Carl E. Grunsky, of San Francisco, past-president of the American Society of Civil Engineers, was elected president of the American Engineering Council at the opening session of the annual meeting of the Council held at the Mayflower Hotel, Washington, January 10 and 11. Mr. Grunsky, who will serve during 1930 and 1931, succeeds Arthur W. Berresford of New York, past-president of the American Institute of Electrical Engineers. Vice-presidents were chosen as follows: L. B. Stillwell, New York, American Institute of Electrical Engineers; Major Gardner S. Williams, Ann Arbor, Mich., Detroit Engineering Society; O. H. Koch, Dallas, Tex., Technical Club of Dallas; L. P. Alford, New York, American Society of Mechanical Engineers. Dr. Harrison E. Howe of Washington, representing the American Institute of Chemical Engineers, was re-elected treasurer. Lawrence W. Wallace of Washington continues as executive secretary.

* * *

DIE AND TOOL BUILDERS ASSOCIATION ELECTS OFFICERS

National Die & Special Tool Builders Association, 40 N. Wells St., Chicago, Ill., recently elected the following officers: President, M. P. Heinze of the Heinze-Petzelt Machine Co.; vice-president, R. Krasberg, of the Krasberg Tool & Mfg. Co.; secretary, George R. Tuthill; and treasurer, Miles Irmis, of the Superior Tool & Stamping Co.

The OHIO Planer Table Type



Horizontal Boring, Drilling and Milling Machines

The Ohio Planer Table Type Horizontal Boring, Drilling and Milling Machine meets the severest precision demands in boring and milling work. The large planer type table permits handling large bulky pieces without loss of accuracy or production. It is built with 4″ and 5″ spindle diameters with table, bed and other dimensions arranged to suit requirements of the work.

Ohio Horizontal Boring, Drilling and Milling Machines are built in all standard types and sizes, meeting all requirements for high grade machine tools of this class.

TABLE TYPE MACHINES

Built with 4″ and 5″ spindle diameters with dimensions, specifications and complete line of attachments to meet the requirements of the modern shop.

FLOOR TYPE MACHINES

Built with 4″ and 5″ spindle diameters, with vertical traverse of spindle up to 7′ 0″ and horizontal traverse of post on runway to suit the job. Bed plates, bar supports, and other accessories to suit requirements. Universal tilting and revolving tables, plain rotary, power operated rotary and stationary work tables.

COMBINATION FLOOR AND TABLE TYPE MACHINES

Built with 4″ and 5″ spindle diameters consisting of standard floor type machine, equipped with table type bed, saddle, bar support either hand or power operated, giving practically all the advantages of the table type machine and with the table unit removed, the great range of the floor type machine is made available.

OHIO MACHINE TOOL COMPANY, Kenton, Ohio

Sole Distributors

JOSEPH T. RYERSON & SON INC.

CHICAGO MILWAUKEE MINNEAPOLIS DULUTH DENVER LOS ANGELES SAN FRANCISCO ROCKFORD
HOUSTON KANSAS CITY TULSA ST. LOUIS CINCINNATI CLEVELAND DETROIT BUFFALO
PITTSBURGH PHILADELPHIA RICHMOND BOSTON JERSEY CITY NEW YORK DALLAS GRAND RAPIDS

TRADE NOTES

FRANKLIN HARDWARE Co. has moved from 37 Howard St., New York City, to 50-52 Franklin St., between Broadway and Lafayette St.

WAGNER ELECTRIC CORPORATION, 6400 Plymouth Ave., St. Louis, Mo., has removed its Chicago sales office and service station to 1935 Indiana Ave.

FAFNIR BEARING Co., New Britain, Conn., has appointed Hoge Piston and Ring, Inc., of Seattle, Wash., distributors for Fafnir ball bearings in the northwestern territory.

GARDNER-DENVER Co., manufacturer of pumps, drill sharpeners, and air compressors, has opened a new branch office at 38 N. Guthrie St., Tulsa, Okla. J. F. Ward is manager of the new office.

LEWIS-SHEPARD Co., Watertown Station, Boston, Mass., has appointed H. A. Stevenson, 7310 Woodward Ave., Detroit, Mich., representative of the Lewis-Shepard line of lift trucks, stackers, and skid platforms in eastern Michigan.

WESTCOTT CHUCK Co., 116 Walnut St., Oneida, N. Y., has appointed G. Douglas Morse, 24 Milk St., Boston, Mass., New England representative of the company. A New York office has recently been opened at 25 Church St. under the direction of P. R. Paulsen.

COOPER HEWITT ELECTRIC Co., Hoboken, N. J., is now known as the GENERAL ELECTRIC VAPOR LAMP Co. The trade name "Cooper Hewitt" heretofore used will be retained as the trade designation of the products manufactured by the General Electric Vapor Lamp Co.

BUFFALO FORGE Co., 144 Mortimer St., Buffalo, N. Y., at a recent stockholders' meeting, elected the following officers: H. W. Wendt, Jr., chairman of the Board of Directors; Edgar F. Wendt, president; Charles A. Booth, vice-president; Edgar F. Wendt, treasurer; and Herbert S. Whiting, secretary.

GRAY IRON INSTITUTE, Terminal Tower Building, Cleveland, Ohio, announces that at a meeting held December 19 at the Hotel Statler, Buffalo, N. Y., steps were taken by members of the Institute in the Buffalo district to form a Buffalo Chapter. This is the first of a series of local chapters to be organized in important foundry centers.

EMPIRE MACHINE AND TOOL Co., 99 Peshine Ave., Newark, N. J., has been organized by Jacob H. Smit and Gustave A. Gebhard to engage in machine building and repairing, the production of dies, jigs, gages, mold work and metal stampings, and experimental work. Mr. Smit is a contributor to MACHINERY and other technical publications.

NIAGARA HUDSON POWER CORPORATION has announced the organization of an Industrial Development Bureau, the main office of which will be located in Albany, N. Y., and which will have branches in Buffalo and Watertown, N. Y. The object of the Bureau will be to aid manufacturing concerns in any part of the country in selecting suitable plant locations.

LEEDS & NORTHRUP Co., 4901 Stenton Ave., Philadelphia, Pa., recently completed an addition to its plant which has increased the floor space from about two to over four acres. The employes of the company held a minstrel show and dance to celebrate the addition to the plant and to welcome new members of the organization, which has grown from 750 to 1150 during the past year.

FALK CORPORATION, Milwaukee, Wis., has made an arrangement with Root, Neal & Co., Buffalo, N. Y., to sell Falk speed reducers and flexible couplings in the Buffalo territory. The company has also appointed the Youngstown Steel Sales, Inc., of Youngstown, Ohio, representative for Falk speed reducers, herringbone gears, special gear drives, and flexible shaft couplings in the Youngstown territory.

BARRETT-CRAVENS Co., 1328 W. Monroe St., Chicago, Ill., manufacturer of lift trucks and truck platforms, announces that the capital stock of the company has been purchased by the WALKER VEHICLE Co. of Chicago, a subsidiary of the Commonwealth Edison Co. THE AUTOMATIC TRANSPORTATION Co., INC., of Buffalo, manufacturer of industrial trucks and tractors, will also be associated with these two companies in ownership and management.

J. A. FAY & EGAN Co., Cincinnati, Ohio, held its annual sales convention in December. Sales representatives from all sections of the United States participated in the three-day meeting, which was held primarily to instruct the sales force in the various features of design and construction of the line of woodworking machinery manufactured by the company. This concern will celebrate its hundredth anniversary this year, and present prospects indicate that it will be a banner year.

STUEBING-COWAN Co., Cincinnati, Ohio, manufacturer of lift trucks and skid platforms, which recently became a part of the Yale & Towne Mfg. Co. of Stamford, Conn., has completed a new plant on Winton Place, Cincinnati. This building will be the first of several units which are required in order to take care of the expansion that has taken place in the Stuebing-Cowan business during the last two years. The first unit makes available three times the production facilities of their old plant.

NORTON Co., Worcester, Mass., has opened another new district service building at Cleveland, Ohio, where a large stock of grinding wheels will be carried. The new building is located at 1306 E. 55th St. It is a two-story structure, 140 feet long by 100 feet wide, made of brick and concrete. It will contain storerooms, offices, a truing room, and service department. A. R. Sandine continues as district manager for the grinding wheel division, and M. E. Mattson as district manager for the grinding machine division. The Cleveland Tool & Supply Co., 1427 W. 6th St., Cleveland, will continue to act as agents for the concern.

OBITUARIES

WILFRED LEWIS, one of the best known mechanical engineers of the country, and president of the Tabor Mfg. Co., Philadelphia, Pa., recently died at sea off Ceylon, on board the SS. *President Wilson*, while on a world cruise with his wife. Mr. Lewis died of apoplexy. He was seventy-five years old.

Mr. Lewis was one of the world's great authorities on the design of gearing, and because of his contributions to the design and construction of gear teeth, he was awarded the American Society of Mechanical Engineers' Medal in 1927, the highest honor that the Society can award to a distinguished engineer. He also received the Longstreth Medal of the Franklin Institute in 1927 for perfecting a molding machine for foundry work. During the war he served in an advisory capacity in Washington and assisted in the development of armored tanks. He took out more than fifty patents in the engineering field.

Mr. Lewis was born in Philadelphia and graduated from the Massachusetts Institute of Technology in 1875. He entered the employ of William Sellers & Co. in Philadelphia, and was, successively, a machinist, draftsman, designer, assistant engineer, and a director of the firm, which he left to become president of the Tabor Mfg. Co. in 1900. From 1901 to 1903 Mr. Lewis was a vice-president of the American Society of Mechanical Engineers.

HARRY L. MONROE, commercial vice-president of the General Electric Co., with headquarters at Chicago, Ill., died at Dallas, Tex., on January 7, following a long illness. Mr. Monroe completed forty years of service with the company in September, 1928, six months after his election to the vice-presidency. Mr. Monroe was born in Parkersburg, W. Va., in 1869. He entered the employ of the company in 1888, with the Thomson-Houston Co. in Chicago. In 1890 he was transferred to the railway department, and in 1894 became a salesman connected with the Dallas office of the General Electric Co. He was made manager of the railway department of the central district in 1905; eight years later he was made district sales manager, and subsequently district manager of the central district, with offices in Chicago.

ARTHUR J. LARMON, president and treasurer of the Rahn-Larmon Co., Cincinnati, Ohio, died December 25 at his home in Cincinnati, following an illness of almost a year. Mr. Larmon was born in Cincinnati forty-four years ago, the son of James Arthur Larmon, one of the pioneers in the barbed wire fence industry in Cincinnati. He attended the Ohio Military Institute and graduated from Kenyon College in 1906. Immediately after his graduation he became identified with the Rahn-Larmon Co. Nine years ago he was made president of the company.

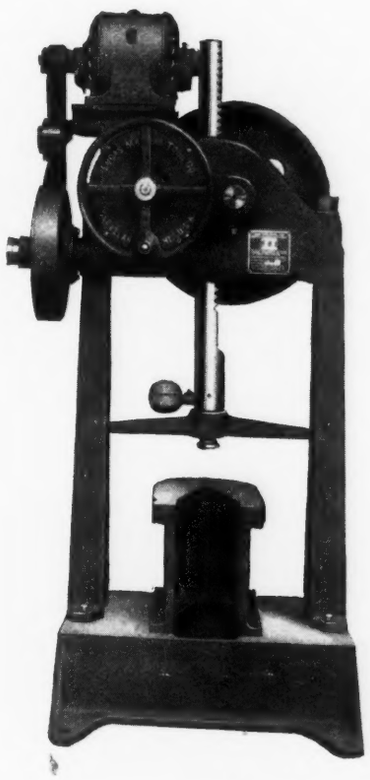
Take Us Into Your Confidence!

We frequently run across some peculiar job that can be done on the

LUCAS
Power Forcing Press

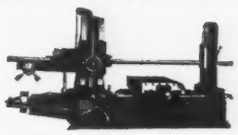
better than on any other machine.

If you have any jobs requiring pressure let us look them over, maybe we can help.



Illustrated Circular
Tells the Whole Story

WE ALSO MAKE THE
"PRECISION"



BORING, DRILLING AND MILLING MACHINE

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

COMING EVENTS

FEBRUARY 7-8—Semi-annual meeting of the American Society for Steel Treating in New York City; headquarters, Hotel Pennsylvania. Secretary, W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

FEBRUARY 18-20—Aeronautic Meeting of the Society of Automotive Engineers at St. Louis, Mo. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

FEBRUARY 25-28—Western Tractor Show at Wichita, Kan. Fred G. Wieland, secretary of the Wichita Thresher and Tractor Club, is manager of the show.

MARCH 3-5—National Management Congress, sponsored by the American Society of Mechanical Engineers, to be held at the Hotel Stevens, Chicago, Ill. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MARCH 5-7—National Materials Handling Meeting, sponsored by the American Society of Mechanical Engineers, to be held at the Hotel Stevens, Chicago, Ill. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

APRIL 5-9—Fiftieth Anniversary Celebration of the American Society of Mechanical Engineers in New York and Washington, D. C. For further information address Calvin W. Rice, secretary, 29 W. 39th St., New York City.

APRIL 7-12—Annual convention and exposition of the American Oil Burner Association at the Hotel Stevens, Chicago, Ill. Executive secretary, Harry F. Tapp, 342 Madison Ave., New York City.

CALENDARS RECEIVED

SIVYER STEEL CASTING CO., Milwaukee, Wis. Large wall calendar for 1930.

NATIONAL TUBE CO., Frick Bldg., Pittsburgh, Pa. Calendar for 1930, showing three months on each sheet.

MOLINE TOOL CO., Moline, Ill., manufacturer of "Hole Hog" drilling machines is distributing a calendar for 1930 to the trade.

GENERAL ELECTRIC CO., Schenectady, N. Y. Calendar for 1930, on each sheet of which is shown a different application of electric equipment.

WHITMAN & BARNES, INC., Detroit, Mich., manufacturer of twist drills, reamers, etc., is distributing a calendar for 1930, showing three months on each sheet.

LOCKWOOD GREENE ENGINEERS, INC., New York City, engineers and architects, are distributing a calendar for 1930, on each page of which is shown a typical example of the factories and other industrial structures designed by this firm.

NEW DEPARTURE MFG. CO., Bristol, Conn., manufacturer of ball bearings, is distributing to the trade a large triple-padded wall calendar for 1930. On one of the pads is printed a decimal equivalent table in large type for convenient reference.

NEW BOOKS AND PUBLICATIONS

PRODUCT ENGINEERING. A monthly journal published by the McGraw-Hill Publishing Co., 370 Seventh Ave., New York City. Price, $2 a year.

This journal is not intended for any special industry, but has been brought out to serve, in a broad and general way, the engineers and designers who are responsible for the planning and designing of the products to be manufactured by an industrial plant. The first number, just off the press, deals, among other subjects, with the design of the General Electric refrigerator, laminated molded materials, high-strength cast iron, and applied art in metal products. A review is also included of electrical parts and accessories recently patented. MACHINERY wishes success to this new journal in the engineering field.

THE FIVE-DAY WEEK IN MANUFACTURING INDUSTRIES. 69 pages, 6 by 9 inches. Published by the National Industrial Conference Board, Inc., 247 Park Ave., New York City.

Increasing attention is being focussed on the five-day week as a basis of plant operation. In order to obtain definite information on this subject, a study has been made of the practical experience of American manufacturers with the five-day week program. The results of this study are published in this book. It shows the extent of the use of the five-day week, the reasons for its adoption, the character of the industries in which it is found, the technique of its operation, and the judgment of business executives as to its effectiveness.

NEW CATALOGUES AND CIRCULARS

WELDING EQUIPMENT. Lincoln Electric Co., Cleveland, Ohio. Bulletin descriptive of the use of the electric arc welding process in constructing pipe lines.

SCREW THREAD GAGE. Jones & Lamson Machine Co., Springfield, Vt. Circular illustrating the Hartometer screw thread gage, and outlining its advantages.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Bulletin 2203, containing data on plugs and receptacles for high-frequency tools. Bulletin 2204, descriptive of interlocking safety switch condulets.

GRINDING AND BUFFING MACHINES. U. S. Electrical Mfg. Co., Los Angeles, Cal. Bulletin announcing the 1930 models of "Auto-Start" grinders and buffers, which are made in both bench and pedestal mountings, with built-in "AutoStart" motor.

DRILLING MACHINES. Western Machine Tool Works, Holland, Mich. Catalogue descriptive of Western heavy-duty radial type drilling machines of "Low Hung Drive" design. The catalogue describes the various details of construction, and illustrates the different sizes.

LATHES. Monarch Machine Tool Co., Sidney, Ohio. Catalogue 131, describing the principal features of Monarch lathes. A complete line of turrets, tool-rests, and tool-room accessories for these lathes is also shown. The book is profusely illustrated with photographs and line drawings.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins GEA-570B, 1142A, 1164, and 1173, illustrating and describing, respectively, hand starting compensators, Type EW resistors for mine and industrial-haulage locomotives, group-operated disconnecting switches, and oil circuit breakers.

PRESSES. Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating Cleveland horning presses, inclinable presses, punch presses, double-crank gap presses, single- and double-crank eccentric presses, double-crank straight-sided tie-rod presses, and single- and double-crank toggle presses.

INDICATING AND RECORDING INSTRUMENTS. Bristol Co., Waterbury, Conn. Catalogue 1009, treating of Bristol's recording pressure and vacuum gages. The construction of the various types is illustrated and described, and full-size reproductions of charts used with the different instruments are included.

FLEXIBLE COUPLINGS. Morse Chain Co., Ithaca, N. Y. Bulletin 37, outlining the uses and advantages of Morse flexible couplings. The principle of design is explained, together with the methods of installing and using these couplings. Complete data is given on the selection of couplings, ratings, dimensions, and prices.

LIGHTING EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Catalogue 219-B, descriptive of lighting equipment suitable for commercial interiors of any type. The catalogue also includes a description of the proper procedure in designing a lighting system and a list of some of the more prominent Westinghouse installations.

GRAY IRON CASTINGS. Gray Iron Institute, Inc., Terminal Tower Building, Cleveland, Ohio. Leaflet entitled "Pointing the Way to Better Castings." This publication urges closer cooperation between the casting buyer and the foundry. It deals particularly with proper pattern equipment as a means toward bringing about large savings in production cost.

CENTERLESS GRINDING MACHINES. Cincinnati Grinders Incorporated, Cincinnati, Ohio. Catalogue illustrating and describing the Nos. 3 and 4 Cincinnati centerless grinders. The bulletin also shows typical jobs handled on these machines, and gives pertinent data for each application. Bulletin descriptive of floor-level type hoppers for automatic centerless grinding machines.

METAL STAMPINGS. Geuder, Paeschke & Frey Co., St. Paul Ave. and 15th St., Milwaukee, Wis. Booklet entitled, "In Harmony with Modern Progress," dealing with the use of pressed-metal stampings. Some of the interesting phases of manufacture are described and numerous examples are shown of products which have been improved in design and produced at lower costs by the use of pressed-metal stampings.

ZINC PRODUCTS. New Jersey Zinc Co., 160 Front St., New York City. Research bulletin on rolled zinc, giving various facts pertaining to zinc in wrought form. The subjects covered include forms and uses; composition and mechanical properties; metallography; physical properties; chemical properties; fabrication and finishing. Research bulletin dealing with the plating of rolled zinc and zinc-base die-castings.

MICROSCOPES. E. Leitz, Inc., 60 E. 10th St., New York City. Pamphlet illustrating and describing in detail the Leitz wide-field binocular microscope, which has been made in a new model with an automatic multiple objective nose-piece for metallography and laboratory work. The multiple nose-piece provides for the automatic interchange of three pairs of objectives at one time. Prices of the different models are included.

INDICATING AND RECORDING INSTRUMENTS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Steel Treating Instrument Data Book, presenting a summary of twenty-three different heat-treatment processes where temperature control is important, including annealing, hydrogen copper brazing, carburizing, etc. Each process is briefly described, the heat-treatment best suited is outlined, and the types of furnaces and instruments used are indicated.

DIE CUSHIONS. Marquette Tool & Mfg. Co., 1904 N. Kilbourn Ave., Chicago, Ill. Catalogue entitled "Better Stampings," containing the result of a survey made in about fifty stamping and pressed metal plants where presses equipped with Marquette die cushions have been used. Illustrations of the work turned out and the machines employed are presented, and complete data is given relating to the jobs, including production. The book also describes in detail the mechanical principles of the Marquette pneumatic die cushion.